Bassetlaw District Council

Strategic Flood Risk Assessment

VOLUME ONE
NON-TECHNICAL SUMMARY

July 2009

FINAL REPORT

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CONTRACT

This report describes work commissioned by Bassetlaw District Council by order number 901008. Bassetlaw District Council's representative for the contract was Richard Schofield. Karen Shuttleworth, Francesca Hurt, Matthew Hemsworth, Richard Roebuck and Georgina Niciecki of JBA Consulting carried out the work.

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PURPOSE

This document has been prepared solely as a Strategic Flood Risk Assessment Report for Bassetlaw District Council. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by Bassetlaw District Council for the purposes for which it was originally commissioned and prepared.

ACKNOWLEDGMENTS

JBA would like to thank all those at Bassetlaw District Council, the Environment Agency, the Idle & Ryton IDB and British Waterways who provided information and data to support this project. Their assistance is gratefully acknowledged.

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EXECUTIVE SUMMARY

This report is a Strategic Flood Risk Assessment (SFRA) for Bassetlaw District Council. It is a Level 2 SFRA that incorporates the requirements of a scoping study SFRA (Level 1) and increased scope SFRA (Level 2). This SFRA has been prepared in accordance with current best practice, Planning Policy Statement 25 *Development and Flood Risk* (PPS25).

The SFRA constitutes one of a number of planning tools that enables the District Council to select and develop sustainable site allocations away from areas of greatest vulnerability to flooding in Bassetlaw. The assessment does not focus on specific development sites. The report discusses the broad scale flood risk within Bassetlaw, and also focuses in more detail on Worksop and Retford, allowing an informed decision to be taken when allocating future development sites. It sets out the procedure to be followed when assessing sites in the future. The SFRA will assist the District Council to make the spatial planning decisions required to inform the Local Development Framework (LDF) for the Bassetlaw area.

The SFRA is intended to be a "live" document, updated when appropriate to reflect changes in the district and as new information becomes available.

Relevant planning, policy and guidance documents have been taken into account in preparing this SFRA. The documents which have been reviewed include national, regional and local planning legislation, together with Environment Agency policy guidance.

A thorough review of existing information and the construction of new hydraulic models has identified the level of flood risk in the Bassetlaw area from fluvial (river flooding) and other sources.

Consultation has been undertaken with Bassetlaw District Council Engineers, the Environment Agency, the Rivers Idle and Ryton Internal Drainage Board (IDB), British Waterways and Severn Trent Water to assess the current flood risk from all sources, including sewers, IDB drains and the Chesterfield Canal.

The Environment Agency Flood Zone Maps are included in the SFRA and are to be used only where more detailed modelling is unavailable. The Flood Zone Maps show indicative flood outlines based on a broadscale assessment of fluvial flood risk only and do not take into account the protection offered by any defences. Hydraulic modelling has been undertaken for the SFRA to establish more realistic indicative flood outlines in key areas that take into account defences and consider how flood water flows within a floodplain. This modelling calculates expected depths and velocities of flood water across the floodplain and allows consideration of the flood risk to people and properties.

In accordance with current guidance, the flood scenarios considered in the SFRA are typically the 1 in 20, 1 in 100 and 1 in 1000 year annual chance flood events, which may also be expressed as 5%, 1% and 0.1% Annual Exceedance Probability (AEP) flood events.

An investigation has been carried out into the effect of defences on flood risk, the level of protection offered by the defences and the risk that remains behind them, for example by failure (due to breach) or overtopping. Purpose built, formal defences have been considered and also other features such as privately owned walls and road and rail embankments, which were not built specifically as flood defences, but which have an impact on the flow of flood water due to their elevated level.

An assessment of the impact of climate change on flood risk in the catchment is a highly important consideration. An allowance for climate change over the 100 year period to 2108 has been included in the assessment of flood risk.

The main flood risk within Bassetlaw is from fluvial flooding.

In Worksop, the River Ryton flows generally West to East with few maintained formal defences. The river passes through culverts in the town centre which are too small to carry a 1 in 100 annual chance flood, resulting in water backing up and flooding out of bank onto the surrounding land. Large open areas of land

have been identified as particularly vulnerable to flooding and also two developed areas within Worksop town centre; firstly around Central Avenue, King Street, Allen Street, and Hardy Street; and secondly around Priorswell Road and Shelley Street.

In Retford the River Idle flows generally from South to North. A significant tributary is the Retford Beck joining the right bank of the River Idle from the East. The Idle has very few formal defences as it flows through Retford. The channel has been widened previously and contains much of the 1 in 20 year annual chance flood flows in bank. There are very few features along the River Idle banks to prevent a 1 in 100 year annual chance flood spilling out of bank onto the adjacent land. Some properties are likely to be affected during a 1 in 100 year annual chance flood, particularly in the vicinity of Chancery Lane. Restriction of flow due to the presence of culverts on the River Idle does not have the same impact as on the Retford Beck, although there is some backing up of flood water due to the culverts under Albert Road and Bridgegate.

The lower reaches of the Retford Beck are heavily culverted and are considerably under capacity to convey the catchment flows, resulting in frequent flooding at culvert entrances.

Trent-side villages are protected by defences and IDB pumps. The River Trent Catchment Flood Management Plan (CFMP) recommends that existing flood risk management activities are reduced over the next 50 – 100 years in the Axholme and North West Lincolnshire Policy Unit which means that flood risk is accepted to increase over time. On the other hand, the CFMP advises that the preferred policy for the Sherwood Policy Unit is to continue with existing activities to manage flood risk at the current level. The towns of Worksop and Retford lie within the Sherwood Policy Unit whereas the lower catchment of the River Idle, including West Stockwith, lies within the Axholme and North West Lincolnshire Policy Unit.

Key villages considered in the SFRA are those with a history of flooding problems and where infill development is likely to have a significant effect on flood risk. Key villages include Clarborough, Hayton, Welham and Walkeringham where land drainage capacity problems are exacerbated by infill development; Sturton le Steeple and Beckingham which are situated on clayey impermeable soils, with poor land drainage and sewer networks and where infill development over the years has had significant impact. North Leverton where a watercourse passes through the village and the potential impact of development with direct sewer outfalls to the watercourse would have significant consequences; and Harworth, which has public sewer capacity problems and an inadequate land drainage system. There are also natural springs in the upstream areas of Harworth and Bircotes which exacerbate surface water problems.

Maps and GIS layers have been provided with the report showing realistic indicative flood outlines that take into account defences, the effect of climate change, residual flood risk from breach and overtopping of the flood defences, flood hazard posed by depth and velocity of flood water and other supporting information.

An overview of flood risk within Bassetlaw DC has been undertaken, allowing the District Council to apply the Sequential Test. It provides advice on any site-specific requirements for a Flood Risk Assessment within the different flood zones, and advises the District Council on the use of the Exception Test, should the Sequential Test be passed.

Guidance for the District Council on the future management of development with respect to flood risk has been given, relevant to the different flood zones and possible types of development.

In addition, an outline has been given of requirements for developers for Flood Risk Assessments, with supporting guidance on reducing flood risk and making development safe, including Sustainable Drainage Systems (SuDS) and flood mitigation measures. Advice is also given on environmental improvement opportunities and other issues to consider as part of a development proposal.

The SFRA is presented in four volumes. Volume 1 provides a non-technical summary of the SFRA process and findings. Volume 2 provides guidance for those using the SFRA. Volume 3 provides a technical summary of methods used to produce the SFRA. Volume 4 includes the mapped outputs of the SFRA.

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ABBREVIATIONS

AEP	Annual Exceedance Probability
AONB	Area of Outstanding Natural Beauty
CC	Climate Change
CFMP	Catchment Flood Management Plan
DEFRA	Department for the Environment, Food and Rural Affairs
EA	Environment Agency
BDC	Bassetlaw District Council
FRA	Flood Risk Assessment
FZ	Flood Zone
Ha	Hectare
JBA	Jeremy Benn Associates Ltd
LDD	Local Development Document
LDF	Local Development Framework
LPA	Local Planning Authority
m AOD	Metres Above Ordnance Datum
MSfW	Making Space for Water
OS NGR	Ordnance Survey National Grid Reference
PPG25	Planning Policy Guidance Note 25
PPS25	Planning Policy Statement 25
RFRA	Regional Flood Risk Appraisal
SFRA	Strategic Flood Risk Assessment
SSSI	Site of Specific Scientific Interest
SuDS	Sustainable Drainage Systems

GLOSSARY

Annual Exceedance Probability	e.g. 1% AEP	Refer to 'probability'.
Brownfield		Brownfield (sites or land) is a term in common usage that may be defined as 'development sites or land that has previously been developed'. Prior to PPS25, the term 'Brownfield' was used in Governmental Guidance and Statements, but in PPS25 has been replaced with 'Previously-developed land'. See 'Greenfield'.
Catchment Flood Management Plan	CFMP	A strategic planning tool through which the Environment Agency will seek to work with other key decision-makers within a river catchment to identify and agree policies for sustainable flood risk management.
Compensatory Storage		A floodplain (flood storage) area introduced to compensate for the loss of storage as a result of filling for development purposes.
Core Strategy	CS	This is the strategic vision of an area and is a central pillar of the Local Development Framework, comprising: A Vision, Strategic Objectives, a spatial land use strategy, core policies and a monitoring and implementation framework. The Core Strategy is a Development Plan Document which will determine overall patterns of future development, identifying broad locations where future growth will take place. All other Development Plan Documents should be in broad conformity with the Core Strategy Document The Core Strategy is a mandatory document, and a timetable for production is set out within the Local Development Scheme.
Defended Area		An area offered a degree of protection against flooding through the presence of a flood defence structure.
Development Plan Documents	DPDs	These documents have Development Plan Status and consequently form part of the statutory development plan for the area. A DPD will be subject to an independent examination. Typical documents that will have DPD status include the Core Strategy, Site-specific Allocations of Land, Proposals Map, and Area Actions Plans (where needed).
Exception Test		An integral part of the risk-based approach at the core of PPS25, the Exception Test is designed to allow for those exceptional circumstances when, for wider sustainability reasons, development not entirely compatible with the level of flood risk may be permitted. For the Exception Test to be passed, all three of its components must be fulfilled.
Flood Estimation Handbook	FEH	Provides current methodologies for estimation of flood flows for the UK.
Flood Hazard		A classification system developed by DEFRA/Environment Agency that gives an assessment of the hazard posed by a flood event at a given location. It is defined using the maximum modelled flood depth, velocity and a factor to allow

		for debris.
Floodplain		Any area of land over which water flows or is stored during a flood event or would flow but for the presence of defences.
Flood Risk Assessment	FRA	A detailed site-based investigation that is undertaken by the developer at planning application stage.
Flood Risk Management		The introduction of mitigation measures (or options) to reduce the risk posed to property and life as a result of flooding. It is not just the application of physical flood defence measures.
Flood Risk Vulnerability Classification		Refer to Section 3.7.
Flood Zone 1	FZ1	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%).
Flood Zone 2	FZ2	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.
Flood Zone 3a	FZ3a	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.
Flood Zone 3b	FZ3b	This zone comprises land where water has to flow or be stored in times of flood. This is 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.
Fluvial Flooding		Flooding caused by the overtopping of river or stream banks.
Formal Defence		A flood defence asset that is maintained by the Environment Agency.
Freeboard		A 'safety margin' to account for residual uncertainties in water level prediction and/or structural performance, expressed in mm.
Functional Floodplain		An area of land where water has to flow or be stored in times of (fluvial) flooding.
Greenfield		Greenfield (sites or land) is a term in common usage that may be defined as 'development sites or land that has not previously been developed'. Prior to PPS25 the term 'Greenfield' was used in Governmental Guidance and Statements, but in PPS25 has been replaced with 'Undeveloped land' See 'Brownfield'.
Informal Defence		A structure that provides a flood defence function, however is not owned nor maintained by the Environment Agency.
Internal Drainage Board	IDB	An Internal Drainage Board is a statutory body that provides storm water management by operating and maintaining an artificial surface water drainage system.

ISIS		1-Dimensional hydraulic modelling software used to demonstrate flow within river channels
JFLOW		Proprietary 2-Dimensional hydraulic modelling software package developed by JBA, which demonstrates overland flow in floodplains
Local Development Framework	LDF	The Local Development Framework is made up of a series of documents that together will form part of the Development Plan. Broadly, Local Development Framework documents fall into two categories: - Development Plan Documents - Supplementary Planning Documents.
Local Development Scheme	LDS	A Local Development Scheme is a public statement of the Council programme for the preparation of Local Development Documents which will form the Local Development Framework.
Local Planning Authority	LPA	Local authority with responsibility for determining whether proposed developments are approved or otherwise.
Main River		A watercourse designated as such by DEFRA that is regulated and maintained by the Environment Agency using their permissive powers.
Measure		A deliverable solution that will assist in the effective management (reduction) of risk to property and life as a result of flooding, e.g. flood storage, raised defence, effective development control and preparedness, and flood warning.
Mitigation		The management (reduction) of flood risk.
Option		Refer to 'measure'.
PAG2		Project Appraisal Guidance (PAG) 2 (Strategic Planning) outlines the DEFRA requirements against which the Environment Agency must demonstrate that they are managing flood risk in a strategic (catchment wide) manner.
Probability	e.g. 1%	A measure of the chance that an event will occur. The probability of an event is typically defined as the relative frequency of occurrence of that event, out of all possible events. Probability can be expressed as a fraction, percentage or a decimal. For example, the probability of obtaining a six with the shake of a fair die is 1/6, 16% or 0.166. Probability is often expressed with reference to a time period, for example, annual exceedance probability. For example, a 1% AEP event is an event with a 1% chance of occurring or being exceeded in any one year.
Proposals Map		This is an Ordnance Survey based map that spatially illustrates policies and proposals within LDDs. The Proposals Map will show planning policy designations and land allocations identified within DPDs, statutory land use and landscape designations and other land and area based designations. It will form part of the statutory

		development plan.
Residual Risk		The risk that inherently remains after implementation of a flood mitigation measure (option).
Return Period	e.g. 1 in 100-Year	The expected (mean) time (usually in years) between the exceedance of a particular extreme threshold. Return period is traditionally used to express the frequency of occurrence of an event, although it is often misunderstood as being a probability of occurrence.
Risk		The threat to property and life as a result of flooding, expressed as a function of probability (that an event will occur) and consequence (as a result of the event occurring).
Sequential Flood Risk Test	SFRT	The assessment and 'categorisation' of flood risk on a catchment-wide basis in accordance with PPS25.
Site Specific Allocations Development Plan Document		A mandatory document, the Allocations Development Plan Document is a high priority item for preparation, details of which are provided in the Local Development Scheme. Prepared in conformity with the Core Strategy, once approved, the Allocations Document will identify sites for development as part of the delivery of the overall planning strategy for the area.
Standard of Protection	SoP	The return period to which properties are protected against flooding
Strategic Flood Risk Assessment	SFRA	The assessment of flood risk on a catchment-wide basis for proposed development in a District
Strategic Flood Risk Management	SFRM	Considers the management of flood risk on a catchment-wide basis, the primary objective being to ensure that the recommended flood risk management 'measures' are sustainable and cost effective
Supplementary Planning Documents	SPD	Supplementary Planning Documents, or SPD, support DPDs in that they may cover a range of issues, both thematic and site specific. Examples of SPDs may be design guidance or development briefs. SPDs may expand policy or provide further detail to policies in a DPD. They will not be subject to independent examination.
Sustainable Drainage Systems	SuDS	Current 'best practice' for new development that seeks to minimise the impact upon the localised drainage regime, e.g. through the use of pervious areas within a development to reduce the quantity of runoff from the development.
TUFLOW		2-Dimensional hydraulic modelling software package with links to ISIS, which demonstrates overland flow in floodplains
Uncertainty		A reflection of the (lack of) accuracy or confidence that is considered attributable to a predicted water level or (modelled) flood extent.
Washlands		Areas which are not susceptible to flooding in a 20 year flood event and hence not classified as Flood Zone 3b, but are considered of vital importance as floodplains and should therefore be treated as functional floodplain

Windfall Sites	Sites that become available for development unexpectedly and are not included in a planning authority's development plan as allocated land.

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1 INTRODUCTION

1.1 Background

In September 2008 JBA Consulting was commissioned by Bassetlaw District Council (BDC), to undertake a Strategic Flood Risk Assessment for Bassetlaw District, which includes the towns of Worksop and Retford and smaller villages.

This SFRA has been prepared in accordance with current best practice, Planning Policy Statement 25 *Development and Flood Risk* (PPS25)[1]. The SFRA will assist the Local Planning Authority (LPA) to make the spatial planning decisions required to inform their Local Development Framework (LDF).

The SFRA is a planning tool that enables the LPA to select and develop sustainable allocations away from the highest flood risk areas. This report sets out the procedure to be followed when assessing sites for development in the future.

The SFRA should be treated as a 'dynamic' document that is periodically reviewed as Bassetlaw District changes or if further information becomes available to provide a better understanding of flood risk. The SFRA should be updated when changes are made to policies or strategy reports relating to flood risk or if conditions change that impact on the nature of flood risk in Bassetlaw, for example the presence and characteristics of flood defences, flood defence schemes or significant development in the district. When the Environment Agency Flood Zone outlines are updated, they should be incorporated into the SFRA.

1.2 Scope and objectives

The overall objective for this SFRA is to provide sufficient information for the application of the Sequential Test and to identify whether application of the Exception Test is likely to be necessary. It involves a broad scale assessment of flood risk to identify sites at flood risk from fluvial and other sources of flooding, utilising existing available information. In addition to this, the SFRA will allow BDC to:

- prepare appropriate policies for the management of flood risk within Bassetlaw;
- inform the sustainability appraisal so that flood risk is taken into account when considering options and in the preparation of strategic land use policies;
- identify the level of detail required for site-specific Flood Risk Assessments (FRA) in particular locations, and
- enable BDC to determine the acceptability of flood risk in relation to emergency planning capability.

1.3 Study Area

Bassetlaw is the northernmost District within Nottinghamshire. It has a population of around 108,000, over half of which live in the towns of Worksop and Retford. Worksop is classified as a sub-regional centre in the draft Regional Spatial Strategy and both towns are likely to be the focus for much of the future development that will take place within Bassetlaw. The west of the District, with clear links to Sheffield and access to the A1, is a focus for employment development.

Otherwise, the District is rural in character, with many small villages and hamlets. Only 17 of the villages have a population of over a thousand. Some of these settlements, notably Harworth and Bircotes, may also be considered for further development. Although it is considered unlikely that any of the smaller villages would be able to sustain significant growth, the SFRA gives due consideration to the relative flooding issues within the District and provides full map coverage.

The River Trent acts as the District's eastern border, while a number of watercourses run through the District, notably the River Ryton, running through Worksop and River Idle, running through Retford. Both pass through or near to other, smaller, settlements on their way through the District. The Chesterfield Canal also runs through Bassetlaw.

The River Ryton flooded in June 2007, overwhelming the existing flood alleviation measures and damaging 273 properties in Worksop, of which 130 properties were residential, while the River Idle broke its banks in a few locations within Retford and Ordsall. Flooding of Retford Beck also impacted upon a number of properties.

It is, therefore, the urban areas of Worksop and Retford for which detailed mapping and flood risk information is provided. A strategic appraisal of flood risk, identifying the flood zones set out in PPS25 is provided for the river corridors in the remainder of the District and 2 dimensional breaches of the River Trent defences.

Figure 1-1: Study Area

1.4 Main sources of flooding

The main flood risk within Bassetlaw is flooding from watercourses (fluvial flooding).

In Worksop, the River Ryton flows generally West to East with few maintained formal defences. The river passes through culverts in the town centre which are too small to carry a 1 in 100 annual chance flood, resulting in water backing up and flooding out of bank onto the surrounding land. Large open areas of land have been identified as particularly vulnerable to flooding and also two developed areas within Worksop town centre; firstly around Central Avenue, King Street, Allen Street, and Hardy Street; and secondly around Priorswell Road and Shelley Street.

In Retford the River Idle flows generally from South to North. A significant tributary is the Retford Beck joining the right bank of the River Idle from the East.

The River Idle has very few formal defences as it flows through Retford. The channel has been widened previously and contains much of the 1 in 25 year annual chance flood flows in bank. There are very few features along the River Idle banks to prevent a 1 in 100 year annual chance flood spilling out of bank onto the adjacent land. Extensive open areas upstream of Retford are likely to flood in a 1 in 100 year annual chance flood and some properties on the perimeter of this flooding might be affected. Also, properties in the vicinity of Chancery Lane are susceptible to fluvial flooding in a 1 in 100 year annual chance flood.

Restriction of flow due to the presence of culverts on the River Idle does not have the same impact as on the Retford Beck, although there is some backing up of flood water due to the culverts under Albert Road and Bridgegate. The lower reaches of the Retford Beck are heavily culverted and are considerably under capacity to convey the catchment flows, resulting in frequent flooding at culvert entrances.

Trent-side villages are protected by defences and IDB pumps. The River Trent Catchment Flood Management Plan (CFMP) recommends that existing flood risk management activities are reduced over the next 50 – 100 years in the Axholme and North West Lincolnshire Policy Unit, which means that flood risk is accepted to increase over time in this area. Some IDB pumping stations may be adversely impacted by the future proposals, which would increase flood risk to some villages in Bassetlaw located in this Policy Unit. However, the EA are currently working on a strategy to find an acceptable compromise and this will be explored in the Isle of Axholme Strategy, which is currently in Draft format. The final report will not be available for some months. The implications for affected villages would be in line with the Flood Zone Maps, which do not show the effects of defences.
On the other hand, the CFMP advises that the preferred policy for the Sherwood Policy Unit is to continue with existing activities to manage flood risk at the current level. The towns of Worksop and Retford lie within the Sherwood Policy Unit whereas the lower catchment of the River Idle, including West Stockwith, lies within the Axholme and North West Lincolnshire Policy Unit.

In addition to fluvial flood risk from watercourses, other potential sources of flooding include the Chesterfield Canal, groundwater, surface run-off during extreme rainfall onto impermeable or saturated ground and flooding from surface water sewers. These issues have been investigated in Worksop, Retford and key villages with a history of flooding problems. Many of the villages in Bassetlaw have their own unique problems associated with lack of capacity in the public sewer network or inadequate land drainage. The worst affected villages and those which would be susceptible as a result of possible infill development have been discussed in this report. Key villages include Clarborough, Hayton, Welham and Walkeringham where land drainage capacity problems are exacerbated by infill development; Sturton le Steeple and Beckingham which are situated on clayey impermeable soils, with poor land drainage and sewer networks and where infill development over the years has had significant impact. North Leverton where a watercourse passes through the village and the potential impact of development with direct sewer outfalls to the watercourse would have significant consequences; and Harworth, which has public sewer capacity problems and an inadequate land drainage system. There are also natural springs in the upstream areas of Harworth and Bircotes which exacerbate surface water problems.

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2 APPROACH TO BASSETLAW STRATEGIC FLOOD RISK ASSESSMENT

2.1 Overview

A SFRA may be sub-divided into two degrees of detail: Level 1 and Level 2. The assessment approach taken for the Bassetlaw SFRA is given below, detailing the requirements at both Level 1 and Level 2. The Bassetlaw SFRA is at Level 2 and therefore incorporates the requirements of both a Level 1 and Level 2 SFRA.

2.2 Level 1 – Scoping Study SFRA

A Level 1 SFRA should be sufficiently detailed to allow application of the Sequential Test and to identify whether the Exception Test is likely to be necessary. Existing data is used to make an assessment of flood risk from all sources now and in the future.

Assessment of Current Flood Risk

Flood risk within Bassetlaw is assessed, categorised and mapped to a level concurrent with the nature and availability of existing data. In general, however, the following key considerations are addressed:

- Identification of known or perceived flood risk areas, including the nature of the flooding problem (e.g. river flooding, local under-capacity drainage) providing the initial 'filter' for key flood risk issues areas within the SFRA area.
- Review of the current Environment Agency Flood Zone Map and mapping of fluvial and tidal flood zones, providing the broad (first pass) definition of High Risk Flood Zone 3.
- Consideration of critical floodplain areas such as washlands and high risk Flood Zone 3b.
- Identification of existing defences that reduce flood risk to potential development locations.

Delineation of Flood Zones

The most recent revision of the Environment Agency Flood Zone Map has been used to delineate Flood Zones in Bassetlaw. The flood zones are precautionary in that they do not take account of flood defences and, therefore, represent a worst-case extent of flooding. The actual extent of flooding is mitigated by flood defences, both formal and informal along some parts of the Rivers Ryton, Idle and Trent. Flood Zone Maps are also limited in that they only consider watercourses with catchments greater than 3 km^2.

The Environment Agency Flood Zone Maps are broad scale and should be considered the least accurate of the flood outlines presented in the SFRA. They should be used only where more detailed 1 dimensional or 2 dimensional modelling, including the effects of defences, is not available.

Review Climate Change and Land Use Management Impact

Climate change has the potential to significantly increase the consequences of flooding. Where available, data which allows for the effects of climate change has been included in the SFRA. Flood Zone Maps with climate change are currently not available. These should be added to the SFRA at a later date when they are available. In the absence of Flood Zone Maps with climate change, an accepted precautionary approach is to use Flood Zone 2 as an approximate outline for Flood Zone 3 with climate change.

Assess Flood Risk from 'Other Sources'

Other sources of flooding include groundwater, possible overland flow during extreme rainfall and flooding from surcharged under-capacity or blocked sewers.

Groundwater is not thought to be an issue in Bassetlaw, although localised problems may occur over time in the vicinity of abandoned mine pumping operations. Site specific investigations will be required for future development close to abandoned mines with monitoring of ground water over a period of time to determine whether the levels have stabilised.

Surface Water maps have been produced illustrating the effects of a 1 in 200 yr chance rainfall event assuming all sewer systems are full to capacity. Flood outlines highlight areas where water is prone to collect and thus highlights the need for further consideration during development planning.

Sewer flooding records were provided by Severn Trent. Areas of past recorded sewer flooding highlight the need for further investigation only – the map is not aimed to preclude all future development at these locations.

Application of the Sequential Test

Guidance for the future management of development within low (Flood Zone 1), medium (Flood Zone 2) and high (Flood Zone 3) flood risk zones is provided, based on the most accurate flood outlines available. Consideration of the requirements for FRAs, and suitable mitigation measures (such as surface water attenuation and SuDS) has been included to assist both developers and planners.

2.3 Level 2 – Increased Scope SFRA

The Level 2 SFRA modelling facilitates the application of the Sequential and Exception Test. It more accurately defines the defended flood outlines and illustrates the variation in risk and hazard within these outlines.

Defended Outlines

The EA Flood Zone outlines are based on broad scale modelling and do not take into account any defences. A more accurate and useful representation is derived from modelling of defended outlines. Defended outlines have been provided within the SFRA for the Rivers Idle, Ryton and Trent, in preference to the EA Flood Zone outlines. A further step is taken in refining the accuracy of the defended outlines by using 2 dimensional TUFLOW modelling. This more detailed modelling demonstrates how flood water interacts with features in the floodplain and has been limited to Worksop and Retford.

Note that in some areas the defended area created during 2d TUFLOW modelling might be larger than the Flood Zone. The modelling for this SFRA to estimate the defended flood outlines uses more accurate techniques than the broad scale modelling of the Flood Zones. In these instances the defended outlines should be considered to be more accurate.

Assessment of Residual Risk

Further investigation is undertaken in areas protected by flood defences to allow a risk based approach to strategic planning. Where defences provide a benefit, breach modelling has been undertaken to demonstrate the possible consequences of a defence failure, or 'residual risk'. This is more useful for planning and regeneration purposes. The SFRA examines the probability, depth, velocity and hazard of flooding if defences are breached or overtopped. Overtopping and breach modelling using TUFLOW has been carried out in Worksop and Retford, although the defences do not provide a major benefit in the towns and the consequences of breached defences here were not found to be severe. Breaches in canal banks within Worksop and Retford have been modelled using JFLOW. Breach and overtopping modelling of the Trent defences has also been carried out using 2 dimensional JFLOW. The flood risk in terms of a hazard rating is assessed according to the methodology given in DEFRA R&D document FD2320[2] and clarified in the Supplementary Note published in May 2008[3].

Variation of Risk within Flood Outlines

The 2 dimensional modelling provides information on how the flood depth and flood hazard varies across the flood outlines, hence providing guidance on whether the flooding is severe, manageable or insignificant.

Level 2 SFRA Outputs

Defended outlines are provided across the District using 1 dimensional modelling. Within the towns of Worksop and Retford the outlines are refined further using 2 dimensional TUFLOW modelling. The variation of risk within the outlines is demonstrated. A more detailed assessment of risk is made using breach modelling. Guidance is given for future development, with recommendations for site specific Flood Risk Assessments, Drainage Impact Assessments and SuDS.

At this stage there may be locations where departures from the Sequential Test are justified by the need to locate development in medium or higher risk zones or in order to meet the wider aims of sustainable development, and the Exception Test is required.

Where major development locations pass parts (a) and (b) of the Exception Test, an assessment must be made as to whether development proposals can pass part (c) of the Exception Test. Recommendations for mitigation methods and emergency planning, reduction of flood risk, and requirements for site-specific FRAs are made. Potential mitigation measures will depend on the proposed end use for the site and defining an acceptable level of residual risk for development proposals.

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3 STRATEGIC FLOOD RISK ASSESSMENT

3.1 Background to Strategic Flood Risk Management Objectives

Historically, the management of flood risk was undertaken in a reactive manner, addressing problems on an as-needed basis in response to flooding events. It was recognised by the Government that this approach was generally not cost effective and often failed to consider individual problem areas within the wider river system.

To address this, the Environment Agency is committed to a rolling programme of flood risk mapping and strategic flood risk management investigations. These include Catchment Flood Management Plans (CFMPs) and Flood Risk Management (PAG2) Strategies within fluvial systems and Shoreline Management Plans (SMPs) within coastal areas.

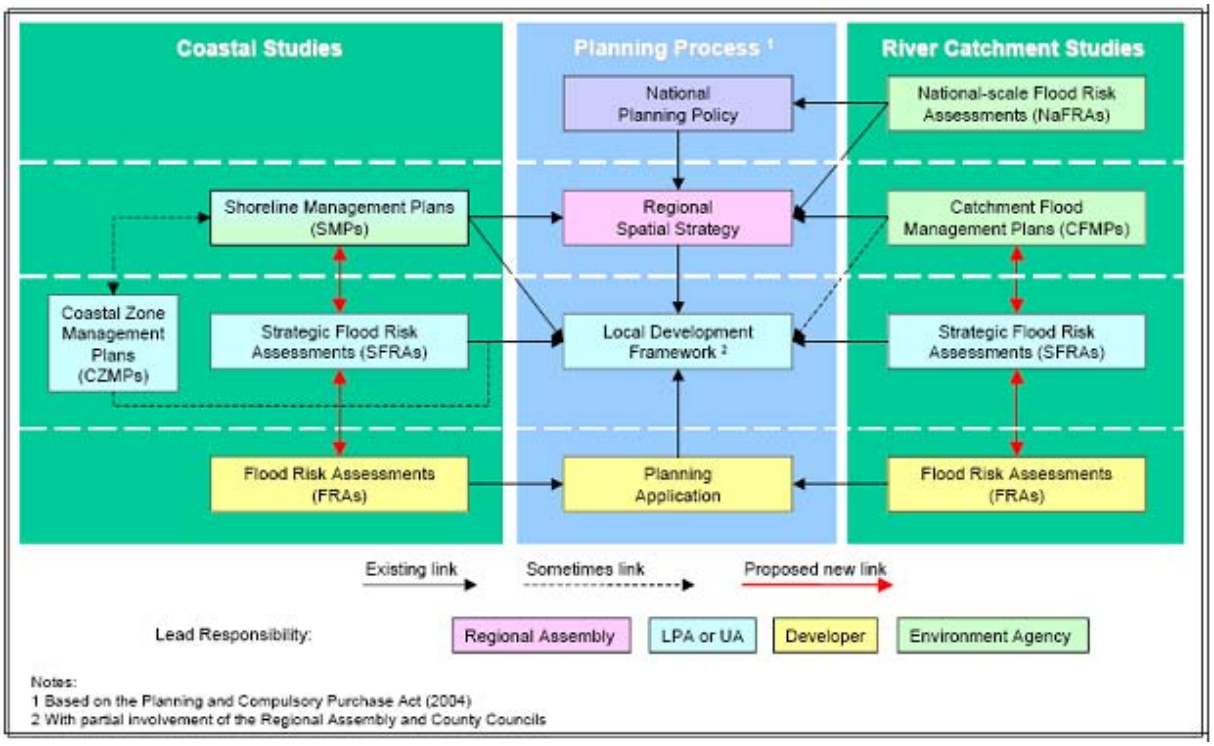
These studies take a catchment-wide approach to flood risk. They identify where flooding is known or perceived to be an existing problem and consider how flooding regimes are likely to alter as a result of climate and land use changes. The studies aim to understand the mechanism of flooding in an area and include assessments of how flooding can be managed in a cost effective and sustainable fashion over the next 50 to 100 years. These investigations also pay particular attention to the environmental implications of flood risk management and seek to provide opportunities for environmental benefit wherever possible.

The importance of influencing both the strategic planning process and development control, by preventing development within flood risk areas is recognised as a key Environment Agency objective. For this reason it is vital that the recommendations of the SFRA are consistent with the long-term strategy for flood risk management in the study area.

3.2 SFRAs and the Planning Process

Figure 3-1 below shows how SFRAs are integrated into the Flood Risk Management and Planning Process.

Figure 3-1: Flood Risk Management and the Planning Process.



The current documents applicable to this SFRA are summarised below:

3.2.1 National Planning Policy PPS25

The primary aim of PPS25 is to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at highest risk. PPS25 was issued as a consultation draft in December 2005 and the final version replaced PPG25 in December 2006.

Development must facilitate the socio-economic needs of a community, and spatially must sit within an existing framework of landscape and infrastructure. For this reason, a balance must be sought between development need and the risk posed to existing and future development in an area.

Catchment boundaries often cover more than one planning district, therefore it is imperative that the planning process ensures that adopted policies are consistent with the longer term vision for the wider catchment, and take adequate account of the impacts that the decisions made may have upon adjoining districts.

The key planning objectives are that, 'Regional planning bodies (RPBs) and local planning authorities (LPAs) should prepare and implement planning strategies that help to deliver sustainable development by:

- 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 a freestanding assessment that contributes to the Sustainability Appraisal of their plans;
- 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 the benefits of the development outweigh the risks from flooding;
- 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 cause 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; re-creating functional floodplain; and setting back defences;
- 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.

The Sequential Test steers new development to areas at the lowest risk of flooding. The Exception Test allows limited scope for departures from the sequential approach where development is essential to meet the wider aims of sustainable development

PPS25 clarifies that the potential impacts of climate change should be addressed in FRAs.

PPS25 uses the amendment to Article 10 of the Town and Country Planning (General Development Procedure) Order 2005 (or GDPO) to make the Environment Agency a Statutory Consultee on all applications for development in flood risk areas (except minor development), including those in areas with critical drainage problems (if defined as "Critical Drainage Areas") and for any development on

land exceeding 1 hectare outside flood risk areas. The Town and Country Planning (Flooding) (England) Direction 2007 also introduces the requirement for LPAs to notify the Secretary of State where they are minded to approve a planning application contrary to a sustained objection by the Environment Agency.

A Practice Guide Companion to PPS25

The Department for Communities and Local Government produced a consultation companion guide to PPS25 in February 2007. The practice guide was published in its final form in June 2008[4].

The practice guide provides guidance on the implementation of the policy set out in PPS25. The document provides further guidance on the preparation of FRAs and SFRAs, implementation of the Sequential and Exception Tests and outlines potential mitigation measures (e.g. SuDS) and risk management techniques.

3.2.2 National-scale Flood Risk Assessment (NaFRA)

The current National Flood Risk Assessment NaFRA 2006 issued by the Environment Agency demonstrates a broad-scale assessment of flood risk at a national scale. It covers 85 river catchments, including the River Trent. The risk is presented in three categories low (less than 1 in 200 chance of flooding); moderate (between 1 in 200 and 1 in 75 chance); and significant (greater than 1 in 75). The document is generally used by insurance companies and the updated NaFRA 2008 is due to be launched in 2009.

3.2.3 Regional Planning Policy - A Regional Approach to Selecting Land for Development

In assessing the suitability of sites for development, priority should be given to making best use of previously developed land and vacant and under-used buildings to achieve national and regional targets. The following criteria should also be considered: physical constraints on the development of land, including the level of contamination, stability and flood risk

3.2.4 River Trent CFMP

The River Trent Catchment Flood Management Plan (CFMP) sets out the Environment Agency's preferred plan for sustainable flood risk management over the next 50–100 years. The River Trent CFMP was adopted in January 2009 and will inform future investment planning.

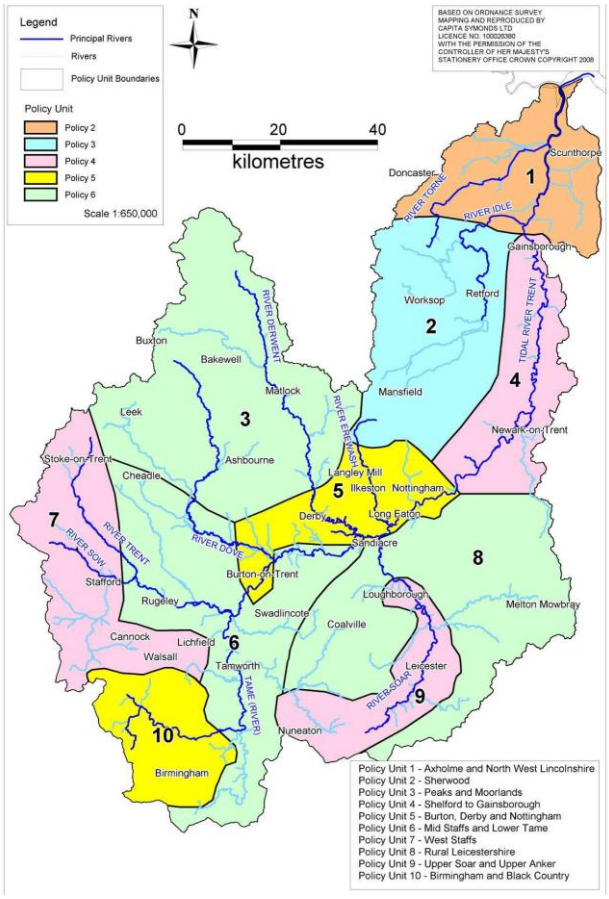
Several policy units fall within the Bassetlaw District Council boundary:

(i) Policy unit 1 – Axholme and North West Lincolnshire

(ii) Policy unit 2 – Sherwood

(iii) Policy Unit 4 – Shelford to Gainsborough

Figure 3-2: Coverage of the Trent CFMP



The towns of Worksop and Retford lie within the Sherwood Policy Unit, the lower catchment of the River Idle, including West Stockwith, lies within the Axholme and North West Lincolnshire Policy Unit and villages along side the River Trent lie within the Shelford to Gainsborough policy unit.

Potential Implications of the CFMP

An assessment of each policy unit is made in the CFMP based on a broad understanding of catchment dynamics. This understanding coupled with detailed hydraulic models determines how each policy unit responds to flooding now and in the future.

Several different policies for each policy unit are considered in the CFMP. For each policy unit one policy is allocated based on how well it meets the catchment objectives set out in the CFMP.

(i) CFMP Policy unit 1 - Axholme and North West Lincolnshire

The policy allocated to this policy unit (policy two) aims to reduce existing flood risk management actions (accepting that flood risk will increase over time).

It is evident that reducing flood risk management actions will have significant consequences in parts of the policy unit, however the policy will allow more focused investment where the need is greater. The CFMP details that whilst tidal flooding will continue to be prevented, fresh water levels will increase. The managed reduction of flood risk activities will be replaced by making space for water schemes in currently drained areas – it is noted that these schemes are subject to further studies.

(ii) CFMP Policy unit 2 - Sherwood

The policy allocated to this policy unit (policy 3) aims to continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time)

The CFMP details that this policy will have a minimal effect in this policy unit, in the short to medium term. The policy includes scope for a change in the current detail of flood risk management and sets out the requirement for improvements in efficiencies and effectiveness within the current level of

flood risk management effort. In the longer term flood depths and flows will increase slightly due to climate change and the number of surface water flood events may increase. This increase in flooding is unlikely to significantly increase the risk to people or disruption to communities.

(iii) CFMP Policy Unit 4 - Shelford to Gainsborough

The policy allocated to this policy unit (policy 4) aims to take further action to sustain the current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change and climate change).

Summary

The CFMP details that flooding in this policy unit will increase due to climate change, and in particular, sea level rise. Improvements to existing flood defences will be made so that flood risk does not increase to an unacceptable level. Relatively minor improvements to existing flood defences are likely to be needed to maintain the current standard of protection. Very little impact on natural habitats or environmental designations is expected. There may be local opportunities within the upper parts of the policy unit to remove some of the low level embankments which currently protect farmland from frequent flooding to allow more frequent inundation of the natural floodplain with little detrimental impact.

3.2.5 Local Planning Policy

Local Planning is limited in its coverage of flood risk issues, which will be addressed through the Local Development Framework Process.

3.3 Policy and Procedural Recommendations

It is recommended that Council policy is reviewed taking account of PPS25 and the SFRA, to ensure appropriate allocation of development sites and implementation of development control. Policies should be put in place which:

- Seek to protect the functional floodplain from development
- Direct vulnerable development away from areas susceptible to flooding
- Ensure new development is safe, with safe access and egress routes for pedestrians and emergency vehicles
- Ensure new development does not have an adverse impact on flood risk elsewhere
- Promote the use of Sustainable Urban Drainage (SuDS) within new developments
- Seek to adopt above ground SuDS as public open space and amenity areas, given appropriate developer contributions via Section 106 Agreements. These contributions should be “ring fenced” specifically for the on-going maintenance of the SuDS facilities
- Seek developer contributions via Section 106 Agreements towards any proposed flood risk management facilities which will provide a direct benefit to their development proposals

Several procedural recommendations are made within the SFRA which clarify and go beyond the current requirements of the EA Standing Advice. These are discussed below:

Additional modelling is required to map flood zones relating to un-mapped watercourses. It is recommended that a FRA is provided for sites within 20m of an un-mapped watercourse which includes hydraulic modelling to delineate as a minimum the 100 year and 100 year with climate change flood outlines and levels.

The Environment Agency is currently a statutory planning consultee on all applications for development in Flood Zones 2 and 3, other than minor development, and for sites of more than 1 hectare in Flood Zone 1. This does not address the problem of the cumulative impact of minor

development, which has proved particularly problematic in certain areas of the District and will continue to cause further problems if not addressed. Also, the Flood Zones relate only to fluvial flooding therefore the flood risk from other sources is not addressed.

Referral of all applications for development to Bassetlaw District Council Drainage Engineers is recommended, regardless of size or Flood Zone, where historical flood risk issues have been identified. The key areas identified are the villages of Clarborough, Hayton, Welham, Walkeringham, Sturton le Steeple, Beckingham, North Leverton, Harworth and Bircotes.

Where proposed developments are designed with surface water outfall connections to soakaways, ditches, rivers or unadopted drainage systems, the Environment Agency are not always consulted in terms of surface water run-off calculations. Connection to a Severn Trent sewer would automatically require the preparation of surface water run-off calculations. Referral of all development applications to Bassetlaw District Council Drainage Engineers is recommended where the surface water drainage outfall connections are not directly to an adopted sewer.

With all applications, it should be demonstrated that proposed developments are not at risk of flooding and that developments do not increase flood risk elsewhere. The surface water drainage from proposed developments should be designed such that peak run-off rates and volumes are attenuated in accordance with the current EA Standing Advice. On small developments, where restriction to very low peak flows makes attenuation impractical, porous / permeable surfaces should be used wherever possible and appropriate.

Planning conditions should be imposed to require the construction of any flood mitigation or surface water attenuation proposals prior to occupations and to put in place appropriate measures to minimise silt run-off and pollution of watercourses and groundwater during construction.

Porous / permeable surfacing such as gravel drives should be used wherever possible and appropriate. Even on relatively impermeable ground there is some potential for infiltration and permeable surfaces can be combined with attenuation and a drainage outfall.

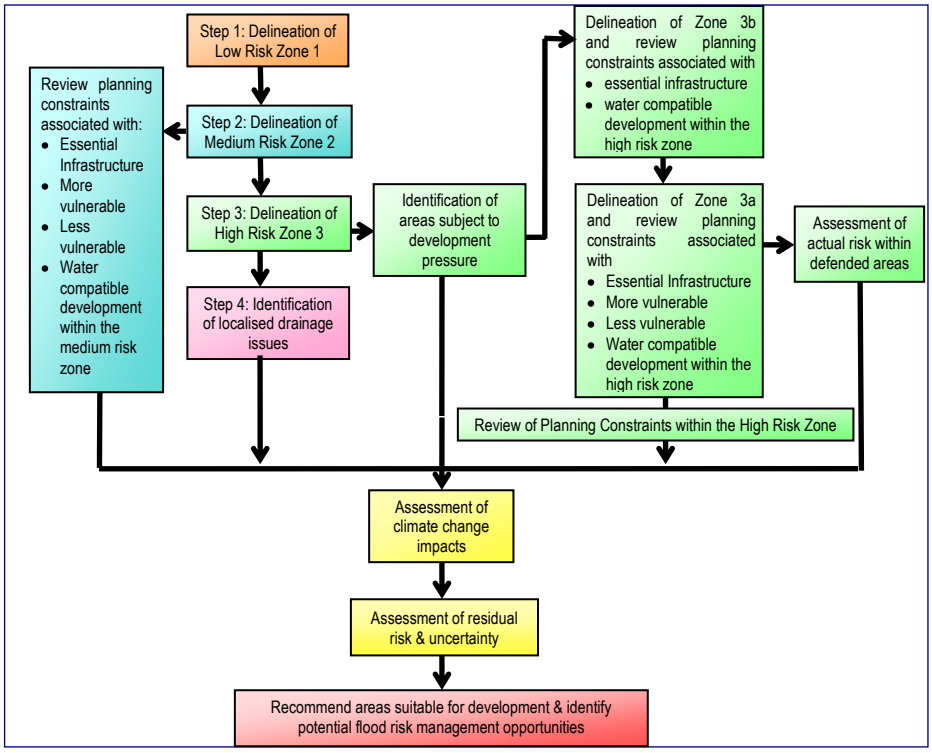
Removal of Permitted Development Rights is justified where development threatens to have a direct, significant and adverse effect on a flood risk, flood defences or management of surface water.

The requirement for FRAs and referral of any development applications to Bassetlaw District Council Drainage Engineers, which are smaller than 1 hectare in key problematic areas and those with no direct outfall connection to an adopted sewer, can be taken forward through the Local Development Framework process.

3.4 Overview of the SFRA Process

The SFRA is a planning tool that can be used to inform the spatial planning process. This process is shown in Figure 3-3 and discussed in more detail below.

Figure 3-3: The SFRA Process



It is the Environment Agency's view, in line with PPS25, that allocations should be made outside of the flood risk areas (i.e. in Flood Zone 1) wherever possible. If there are no reasonably appropriate Flood Zone 1 sites, allocations should be made in Flood Zone 2 first, considering flood risk vulnerability of land uses. Only where there are no reasonably available sites in Flood Zones 1 or 2 should Flood Zone 3 allocations be made. In order to demonstrate that there are no lower risk sites available the Sequential Test needs to be carried out. The information provided in the SFRA will allow the LPA to carry out the Sequential Test.

Only on completion of the Sequential Test should the Exception Test be used to justify allocations or developments in high risk areas where the need to develop is considered exceptional.

The SFRA deliverables are a report and suite of maps to allow the sequential testing to take place within the LDF.

Within defended floodplains, the Sequential Test requires a more detailed assessment of probability and consequences. Risk is defined as a function of both probability of an event occurring and the consequence should that event take place and is dependent on the vulnerability of the intended land use.

To assess risk, it is necessary to model the consequence of overtopping and breaches of defences, in 1% (100 year) and 0.1% (1000 year) probability events. Generally, the worst case scenario will coincide with a failure of the defences, where they are present, at the peak of the flood event. To this end, a two dimensional inundation model (which has the ability to predict depth and velocity) of the defended area is required to examine the impact of either a breach failure or overtopping during the design event.

3.5 Sequential Test – PPS25

PPS25 provides the basis for the sequential approach; it recommends that LPAs use a risk based approach to development planning and specifies the need for undertaking SFRAs in Annex E.

When allocating or approving land for development in flood risk areas, those responsible for making development decisions are expected to demonstrate that there are no suitable alternative development sites located in lower flood risk areas.

The methodology introduces a Sequential Test that is core to the SFRA process. The basis of the test is classification into high, medium and low flood risk using defended flood outlines derived from 1 dimensional modelling within the District as a whole, and from more accurate 2 dimensional modelling within the towns of Worksop and Retford. For the purposes of the SFRA, the more detailed modelling re-defines Flood Zones 1, 2 and 3.

BDC will be required to prioritise the allocation of land for development in ascending order from Low Risk to High Risk, including the subdivisions of Flood Zone 3, if necessary. The Environment Agency is a specific consultation body on certain Local Development Documents and is a statutory planning consultee. The Environment Agency must be consulted on all development applications allocated with medium and high risk zones and for any development on land exceeding 1 hectare outside Flood Zones 2 and 3. In these circumstances, the Environment Agency will require the LPA to demonstrate that there are no reasonable alternatives in lower flood risk zones that are available for development. Where appropriate, the Exception Test is to be applied.

3.6 The Exception Test

Where departures from the Sequential Test are justified by the need to locate development in Flood Zones 2 or 3, it is necessary to apply the Exception Test. PPS25 acknowledges that flood risk is one of many issues (including transport, housing, economic growth, natural resources, regeneration and the management of other hazards) which need to be considered in spatial planning.

PPS25 explains where and for what type of development the Exception Test needs to be applied. In some situations, for certain types of development, it is not appropriate to use the Exception Test to justify development; for example, development which is highly vulnerable to flooding cannot be justified within Flood Zone 3 through the use of the Exception Test. The situations where it is necessary and appropriate to apply the Exception Test are outlined below.

Where the Exception Test is required, it should be applied as soon as possible to all Local Development Document (LDD) allocations for development and all planning applications other than for minor development[5]. All three elements of the Exception Test have to be passed before development is allocated or permitted. For the Exception Test to be passed:

a. *It must be demonstrated that the development provides wider sustainability benefits to the local community that outweigh flood risk, informed by an SFRA, where one has been prepared. If the Development Plan Document (DPD) has reached the 'submission' stage – see Figure 4 of PPS12: Local Development Frameworks – the benefits of the development should contribute to sustainability;*

b. *The development should be on developable previously developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable, previously developed land; and*

c. *A Flood Risk Assessment must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

PPS25 (paragraphs D11 and D12) states that the Exception Test 'should be applied to LDD site allocations for development and used to draft criteria-based policies against which to consider planning applications. Where the Exception Test has been applied in LDD allocations or in criteria-based policies, the local planning authority should include policies in its LDDs to ensure that the developer's FRA satisfies criterion c). The Environment Agency and other appropriate operating authorities, such as Internal Drainage Boards, should be consulted on the drafting of any policy intended to apply the Exception Test at a local level.'

Compliance 'with each part of the Exception Test should be demonstrated in an open and transparent way.' Table 3-2 summarises the applicability of the Exception Test for different development sites; for example, housing allocations are classified as 'more vulnerable' and employment allocations are 'less vulnerable'. At present no allocation sites have been defined within Bassetlaw.

3.7 Flood Risk Vulnerability Classification

In PPS25 different types of development are divided into five flood risk vulnerability classifications (see Table 3-1):

Table 3-1: Flood Risk Vulnerability Classification

Essential Infrastructure	• Essential transport infrastructure and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations and emergency dispersal points. • Basement dwellings, caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.
More Vulnerable	• Hospitals, residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwellings, student halls of residence, drinking establishments, nightclubs, hotels and sites used for holiday or short-let caravans and camping. • Non–residential uses for health services, nurseries and education. • Landfill and waste management facilities for hazardous waste.
Less Vulnerable	• Buildings used for shops, financial, professional and other services, restaurants and cafes, offices, industry, storage and distribution, and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities), minerals working and processing (except for sand and gravel). • Water treatment plants and sewage treatment plants (if adequate pollution control measures are in place).
Water-Compatible Development	• Flood control infrastructure, water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves, navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation. • Essential sleeping or residential accommodation for staff required by uses in this category, subject to a warning and evacuation plan.

Notes:

1) *This classification is based partly on DEFRA/Environment Agency research on Flood Risks to People (FD2321/TR2) and also on the need of some uses to keep functioning during flooding.*
2) *Buildings that combine a mixture of uses should be placed into the higher of the relevant classes of flood risk. Developments that allow uses to be distributed over the site may fall within several classes of flood risk sensitivity.*
3) *The impact of a flood on the particular uses identified within this flood risk vulnerability classification will vary within each vulnerability class. Therefore, the flood risk management infrastructure and other risk mitigation measures needed to ensure the development is safe may differ between uses within a particular vulnerability classification.*

Source: PPS25 Table D2

Table 3-2: Flood Risk Vulnerability and Flood Zone Compatibility

Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test	✓	✓
	Zone 3a	Exception Test	✓	✘	Exception Test	✓
	Zone 3b	Exception Test	✓	✘	✘	✓

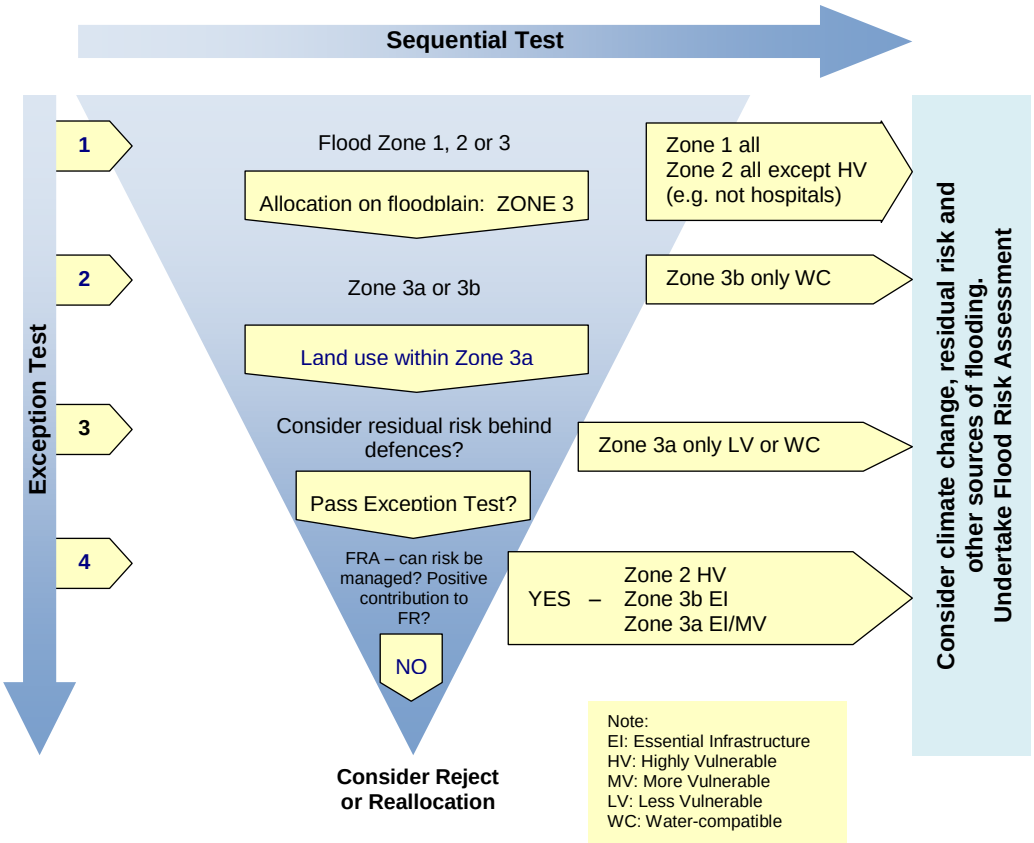
Key:

✓ Development is appropriate

✘ Development should not be permitted

Source: PPS25 Table D3

Figure 3-4: The Sequential and Exception Tests



3.8 Flood Zone 3a – High Probability

PPS25 states that water-compatible and less vulnerable developments are permitted in this Flood Zone, following testing within the sequential process. According to PPS25, highly vulnerable development is not permitted. Essential infrastructure and more vulnerable development need to

pass the Exception Test, while essential infrastructure should be designed and constructed to remain operational and safe for users in times of flood.

According to PPS25, developers and local authorities should address the following policy aims:

- Reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of SuDS.
- Relocate existing development to land in zones with a lower probability of flooding.
- Create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.[6]

Therefore a presumption for further development in existing floodplains is not supported by PPS25, and any future SFRA should review existing areas to see if relocation is a spatially sustainable strategy.

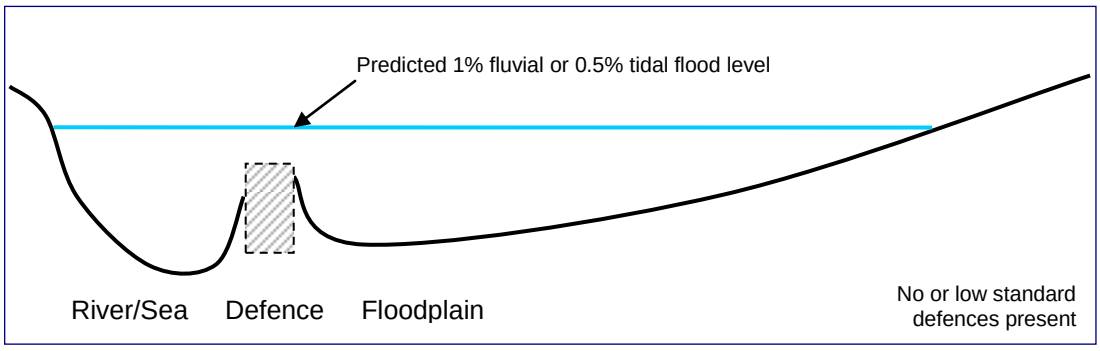
Regeneration of land or change in land use behind existing defended areas in the high risk Zone will require a more detailed assessment of the flood risk (i.e. whether the scale of flood risk is worth taking, and how sustainable and effective the mitigation measures would be [i.e. whether the risk could be managed]). Where, due to wider sustainable development reasons there are no other suitable sites available in lower risk zones, an assessment of the risk within Flood Zone 3 is required. Annex G in PPS25 deals with managing residual flood risk. Maps showing the variation in flood depth and hazard across Flood Zone 3 for areas where 2 dimensional modelling has been carried out can be found in volume 4.

Flood Zone 3a should not be used for development where suitable alternative sites exist in Flood Zones 1 or 2. Paragraph G2 of PPS25 states that following application of the Sequential Test and Exception Test for development in Flood Zone 3a, a clear examination of the residual flood risks should be made and development:

*'Should **not** normally be permitted where flood defences, properly maintained and in combination with agreed warning and evacuation arrangements, would not provide an acceptable standard of **safety** taking into account climate change.'* [6]

In the context of this discussion, an **undefended area** (Figure 3-5) of floodplain under fluvial flood risk is considered to be an area where the water level for the 100 year fluvial flood event will be similar to that of the river. These areas may be entirely undefended, or if defences are present, they are discontinuous or constructed to a low standard. In these areas guidance provided in Section 3.8.1 (undefended areas) will be most relevant in assessing sustainability and determining mitigation requirements.

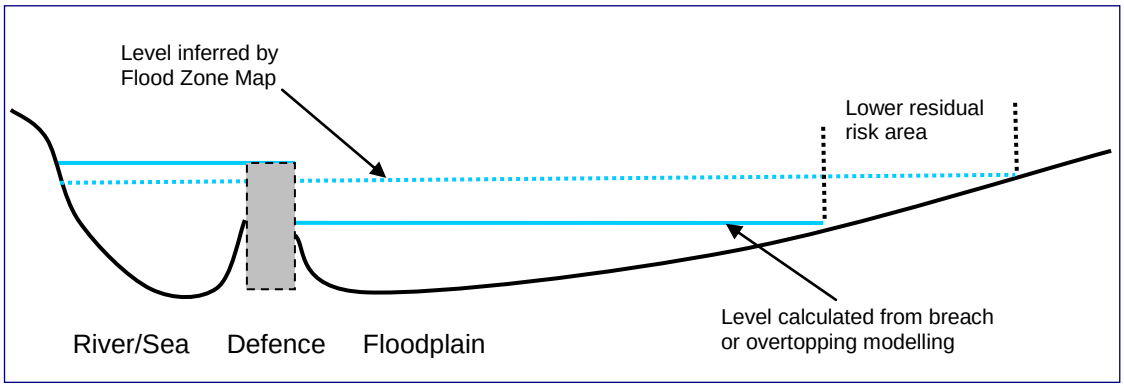
Figure 3-5: Illustration of the undefended scenario under fluvial and/or tidal flood risk



A defended area is considered to be an area of floodplain where the defences will result in a water level for the 100 year fluvial flood event that is considerably lower than the source river. This means the defences substantially (but not necessarily completely) mitigate the flood risk associated with the 100 year fluvial flood event. These areas will be defended to a minimum standard promoted by DEFRA, but not always necessarily to the 100 fluvial standards. In these areas guidance provided in

Section 3.8.2 (defended areas) will be most relevant in assessing sustainability and determining mitigation requirements. Areas which are defended are highlighted in this report.

Figure 3-6: Illustration of the defended scenario and residual flood risk behind fluvial/tidal defences



3.8.1 Undefended Areas – Flood Risk Mitigation

The Sequential Test should first be applied to assess reasonably alternative locations suitable for the proposed development at a lower probability of flood risk. If this proves unsuccessful the Exception Test may be required.

The Sequential Test should then be applied within the development location area, and it is considered appropriate to direct more vulnerable land uses to parts of the location at a lesser probability and lower residual risk of flooding. The lower floors of buildings in areas at both medium and high probability of flooding should seek to develop water-compatible and less vulnerable uses, including car parks or other public areas.

Within undefended or poorly defended Flood Zone 3a areas, floor levels for housing developments should, as a minimum, be situated above the acceptable standard of safety with sufficient freeboard to allow for uncertainties in flood level prediction and climate change.

Housing developments (more vulnerable development) should provide a minimum habitable space floor level above the estimated 100 year (for fluvial flooding) water level with the addition of allowances for modelling uncertainty and climate change (i.e. freeboard). This may be achieved by providing car parking or other public areas at ground floor level.

Employment development (less vulnerable development) should provide a similar standard of flood defence as housing developments. Within undefended or poorly defended Flood Zone 3a areas, employment development should remain dry during the 100 year fluvial flood event, with sufficient freeboard to account for uncertainties in flood level prediction and climate change. Developers will need to carefully consider the commercial viability of developing in these areas. In exceptional circumstances, where there is significant planning justification for development and the provision of this standard of defence is not feasible, a greater acceptance of flood risk may be permitted for less vulnerable development in areas of high probability of flooding with the focus on providing safety to occupants, flood proofing and designing buildings to minimise flood damage.

Flood resilient construction may be considered in circumstances where there is a low probability of limited shallow depth water entry and buildings are not subjected to severe floodwater inundation depths. This type of construction is designed to reduce the consequences of flooding (the probability of flood occurrence remains unchanged) and facilitate recovery from the effects sooner than conventional buildings.

This may be achieved ‘through the use of water-resistant materials for floors, walls and fixtures and the positioning of electrical controls, cables and appliances at a higher than normal level’[6] and flood resistant construction to either reduce the amount of water or prevent entry of water into a building where resistant techniques are used. PPs25 Annex E and G state that a means of safe access and egress in times of flooding must be provided so that at a minimum, emergency services and their vehicles are able to evacuate people, especially when considering those that are more vulnerable and/or with restricted mobility.

Whilst the basic level of protection afforded to residential and commercial development is the same, it is clear that approaches to how residual risk is managed may differ between these two types of developments. For residential development residual risk is a societal issue, for which a presumption of avoidance and removal is appropriate. Hence a significant freeboard should be incorporated into housing development floor levels, whereas for a commercial property the end user and insurer can assess and transfer this residual risk as appropriate. Therefore commercial and employment uses have a suitably different approach to the management of the residual risk, above that provided by the basic mitigation works. The onus would be on BDC to determine whether these risks are acceptable, in conjunction with advice from the Environment Agency.

For a development to proceed, it must also be shown that it will not increase flood risk elsewhere through a loss of storage or conveyance. Flood risk must be reduced or kept at current levels.

3.8.2 Defended Areas – Flood Risk Mitigation

Within defended areas, residual flood risk is primarily associated with overtopping and/or breach of defences (and localised flooding associated with drainage systems in some locations). These risks are related to the likelihood (standard of protection and structural integrity of defences) and the consequences of flooding.

The likelihood of overtopping can be estimated by comparison of modelled water levels (where available) and defence crest levels. An indication of the likelihood of defence breach can be gained by reviewing the flood defence condition data held within the National Flood and Coastal Defence Database (NFCDD), although this information was limited within Bassetlaw, and by more detailed surveys and investigations. The consequences of defence overtopping or breach failure can be estimated using flood inundation modelling and mapping.

In Bassetlaw some defences are present on the Rivers Idle and Ryton, however their effect is minimal within the towns of Worksop and Retford. The Idle defences downstream of Retford provide a more significant benefit. Defences offer significant protection to the Trent-side villages within the District.

For a development to proceed, it must also be shown that it will not increase flood risk elsewhere through a loss of storage or conveyance. Flood risk must be reduced or kept at current levels.

The feasibility of any proposed mitigation measures which might be introduced to address any residual flood risk may be assessed in accordance with the guidance established in Volume 2.

A site-specific FRA should be undertaken at the planning application stage to facilitate the delineation and definition of the 100 year fluvial flood outline and level including an allowance for the future effects of climate change.

3.8.3 Public Safety

For all Flood Zone 3a potential development locations consideration must be given to residual risks and the risk to public safety associated with access and egress from properties.

Development should not be sited where these risks would unduly threaten public safety and/or the structural integrity of buildings and infrastructure. Consideration of the depth of flooding, flow velocity, rate of inundation and safe access / egress is required to assess these risks.

Reference should be made to Hazard maps where available.

3.9 Flood Zone 3b – The Functional Floodplain

PPS25 states that only water-compatible uses are permissible in Flood Zone 3b. Essential Infrastructure can be permitted after the Exception Test is passed. According to PPS25, developers and local authorities should aim to:

- Reduce overall level of flood risk in the area through the layout and form of the development and the appropriate application of SuDS.
- Relocate existing development to land with a lower probability of flooding.

In addition, according to PPS25, essential infrastructure should:

- Remain operational and safe for users in times of flood.
- Result in no net loss of floodplain storage.

- Not impede water flows.
- Not increase flood risk elsewhere.6

Other than water-compatible and essential infrastructure (subject to the Exception Test), Flood Zone 3b should not be used for development except for access road purposes. In this case, the roadway should be kept to the narrowest width possible and crossing the watercourse at 90 degrees to the direction the watercourse flows.

It is generally accepted that the 20yr flood event is taken to be the functional floodplain. However, this can vary for specific locations, such as the washlands adjacent to the River Trent and the lower reaches of the River Idle, which are not susceptible to flooding in a 20 year flood event, but are considered of vital importance as floodplains. Through Retford, a modelled 20 year outline was not available for the River Idle and therefore the 25 year modelled outline has been taken to represent Flood Zone 3b. The functional floodplain within Bassetlaw is shown on drawings in Volume 4.

3.10 Flood Zone 2 – Medium Probability

Flood Zone 2 is considered suitable for water-compatible, less vulnerable, more vulnerable and essential infrastructure. Highly vulnerable development is only allowed where the Exception Test is passed.

In this zone, developers and BDC should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of SuDS.

Where development is implemented, floor levels should be situated, as a minimum, above the 100 year fluvial flood level with sufficient freeboard to account for inherent uncertainties with respect to flood level prediction and potential climate change scenarios. A site-specific FRA should be undertaken at the planning application stage to facilitate the delineation and definition of the 100 year fluvial flood outline and level including the future effects of climate change.

3.11 Flood Zone 1 – Low Probability

In accordance with PPS25, all development (essential infrastructure, highly vulnerable, more vulnerable, less vulnerable and water-compatible development) is permissible in Flood Zone 1.

Development proposals on sites comprising one hectare or more will require a FRA in accordance with PPS25.

Through referral to Bassetlaw DC Engineers, a FRA should be provided for all developments, regardless of size, in areas where a known flooding problem has been identified, ie the key villages of Clarborough, Hayton, Welham, Walkeringham, Sturton le Steeple, Beckingham, North Leverton, Harworth and Bircotes to ensure that the proposed development does not result in a worsening of existing flooding conditions. The FRA should include details of drainage proposals, including SuDS, that will mitigate against any increased run-off rates and volumes from the proposed development.

Due to the limitations of the scope of the SFRA, flood outlines have not been produced for smaller watercourses. Therefore a FRA should be provided for all proposed developments, regardless of size, within 20m of any watercourse, to determine the associated flood risk.

A FRA should also be provided for review by Bassetlaw DC engineers, for all developments regardless of size that do not discharge to an adopted sewer. This is to ensure that the cumulative effect of small developments does not go un-checked. The FRA should include details of drainage proposals, including SuDS, that will mitigate against any increased run-off rates and volumes from the proposed development.

Ideally the LPA should work closely with the Environment Agency, sewerage undertakers, highway Authority and developers to enable surface water runoff to be controlled as near to the source as possible. For Greenfield developments, the aim is not to increase runoff from the undeveloped situation and for Brownfield re-developments, to reduce existing runoff rates. Wherever possible, this should be achieved through the implementation of a sustainable drainage or flow retention system, constructed within the boundaries of the development site.

The effectiveness of a flow management scheme within a single site is heavily limited by site constraints including (but not limited to) topography, geology (soil permeability), development density, adoption issues and available area. The design, construction and ongoing maintenance regime of such a scheme must be carefully defined at an early stage, and a clear and

comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential. In these areas a FRA will be required that demonstrates that the proposed development will not adversely affect existing flooding conditions either alone or in combination with other development.

Prior to making a planning application, discussions should be held with the Environment Agency, the Local Planning Authority and Severn Trent Water to ascertain the specific nature and most appropriate means of managing the flood risk.

The integration of drainage management is highlighted within the DEFRA strategy for flood risk management in England, detailed within the consultation document 'Making Space for Water'[7]. The strategy aims to achieve better overall management of surface water drainage through better co-ordination between the different bodies.

4 EXISTING FLOOD RISK DATA

4.1 Data Collection

The table below lists the data that was made available/obtained for the Bassetlaw SFRA. This data comprises known or perceived flood risk issues within the district, development pressures and constraints and current policy governing development within flood risk affected areas. The majority of this data has been recorded and included in the GIS data layers used to undertake the assessment.

Table 4-1: Data availability for use in the Bassetlaw SFRA

Data Type	Use within SFRA
OS 10k Basemap	Flood Risk Mapping
Flood Zone Map	Initial Flood Zone delineation
Main river map	Flood Risk Mapping
National Flood and Coastal Defence Database (NFCDD) data	Demonstrate defended and undefended areas
LiDAR Digital Elevation Model	Flood Risk Mapping
NEXTMap Digital Elevation Model	Flood Risk Mapping, where LiDAR coverage insufficient
River Ryton hydraulic model	Flood Risk Mapping
River Idle hydraulic model	Flood Risk Mapping
Tidal Trent hydraulic model	Flood Risk Mapping
Catchment Flood Management Plan	Background information
Internal Drainage Board maps	Background information, flood risk
British Waterways Maps	Background information, flood risk
BDC Engineers maps and reports	Background information, flood risk

4.2 Existing Flood Risk Studies

4.2.1 River Idle Flood Risk Mapping Study (March 2005)

This study was carried out by JBA Consulting for the Environment Agency. It is the only comprehensive modelling exercise on the River Idle post completion of several phases of flood alleviation works from the 1970's onwards. The River Idle model commences at the confluence with the Rivers Maun and Poulter, south of Retford, and ends at the outfall with the River Trent at West Stockwith pumping station.

Information is available in this study for a range of return periods, producing defended flood outlines up to the 1 in 200 year flood event. Information was not available for a 100 year climate change scenario or 1000 year scenario.

Flood alleviation on the River Idle consists of a number of designated washland areas, previous regrading of the River Idle channel and construction of flood embankments. As part of the River Idle Study a breach analysis was carried out using JFLOW software to establish the impact upon the villages of Misson and Mattersey.

4.2.2 Tidal Trent Strategy (July 2005)

This study was undertaken by Black & Veatch Consulting Ltd for the Environment Agency. It builds upon existing flooding information available for the tidal stretch of the River Trent from Cromwell Lock to Trent Falls. The study establishes the extent of the 1 in 100 year floodplain of the River Trent and the condition and standard of flood defences. The report identifies the area likely to be at risk of flooding if the defences failed, however this has been produced using 1-dimensional software and is therefore only a broadscale indication.

This study does not, unfortunately, contain any climate change flood maps or associated flood levels.

4.2.3 Retford Beck

The Environment Agency has recently completed a Preliminary Strategic Review (PSR) of the Retford Beck, which investigated flood alleviation options. It is possible that the findings of the PSR will be taken forward by the Environment Agency's National Capital Programme Management Service (NCPMS) as part of a Feasibility Study looking at the environmental, economic and social impacts of a flood alleviation scheme.

4.2.4 River Ryton Flood Risk Mapping Study (March 2008)

This study was undertaken by JBA Consulting for the Environment Agency. It provides flood mapping for a range of return periods, including climate change outlines, for the River Ryton from Worksop Road in Lindrick to the confluence with the River Idle near Bawtry. The River Ryton study also includes modelling of Oldcotes Dyke.

The River Ryton study established that flooding to Worksop Town Centre begins at about a 1 in 50 year flood event and that there are only limited sections of formal flood defences along the River Ryton immediately upstream of its confluence with the River Idle.

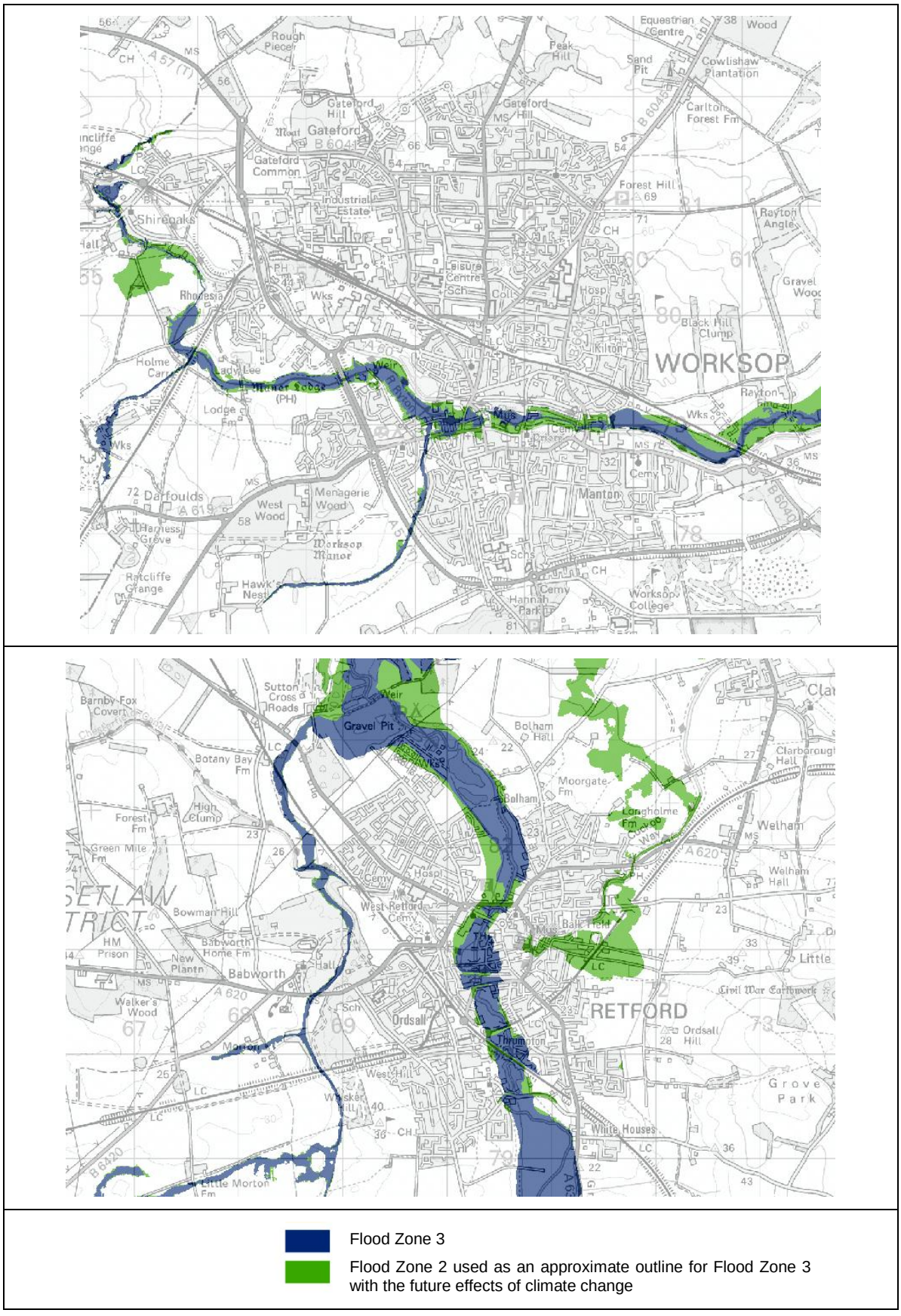
4.3 Flood Zone Map

The Environment Agency Flood Zone Map shows the areas at risk from extreme events from river and tidal flooding. The Flood Zone maps were prepared using a methodology based on the national digital terrain model (NEXTMap), derived river flows (Flood Estimation Handbook (FEH)) and two dimensional flood routing. The theoretically derived Flood Zone extents have been adjusted in some locations where the results are inconsistent with historical flooding extents, more detailed flood mapping studies are available or where there are known errors in the digital terrain model.

The Environment Agency Flood Zone maps are precautionary in that they do not take account of flood defences and, therefore, represent a worst-case extent of flooding. The actual extent of flooding within Bassetlaw is mitigated to some degree by flood defences along the Rivers Ryton, Idle and Trent. It should be noted that the Flood Zone Maps are based on broadscale modelling and only cover watercourses with catchments greater than 3 km^2 in size, therefore flood risk associated with smaller watercourses is not shown. The most recent revision of the Environment Agency Flood Zone Map has been used to delineate Flood Zones in Bassetlaw and the full maps are included in Volume 4.

Flood Zone Maps including the expected future effects of climate change are not currently available, however it is expected that the extent of the Flood Zone outlines will increase over time. A comparison is shown below of the current extents of Flood Zone 3 and the expected approximate outline of Flood Zone 3 in the future (based on the current Flood Zone 2 outline). When the Flood Zone Maps with climate change are available they should be added to this SFRA.

Figure 4-1: EA Flood zone 3 and Flood Zone 2 (used to approximate 'Future' Flood Zone 3) Worksop and Retford



4.4 Flood Defences

As discussed above, the Environment Agency Flood Map does not take account of the presence of flood defences. PPS25[8] states that defended areas (i.e. those areas that are protected to some degree against flooding by the presence of a formalised flood defence) are still at risk of flooding, and therefore sites within these areas must be assessed with respect to the adequacy of the defences.

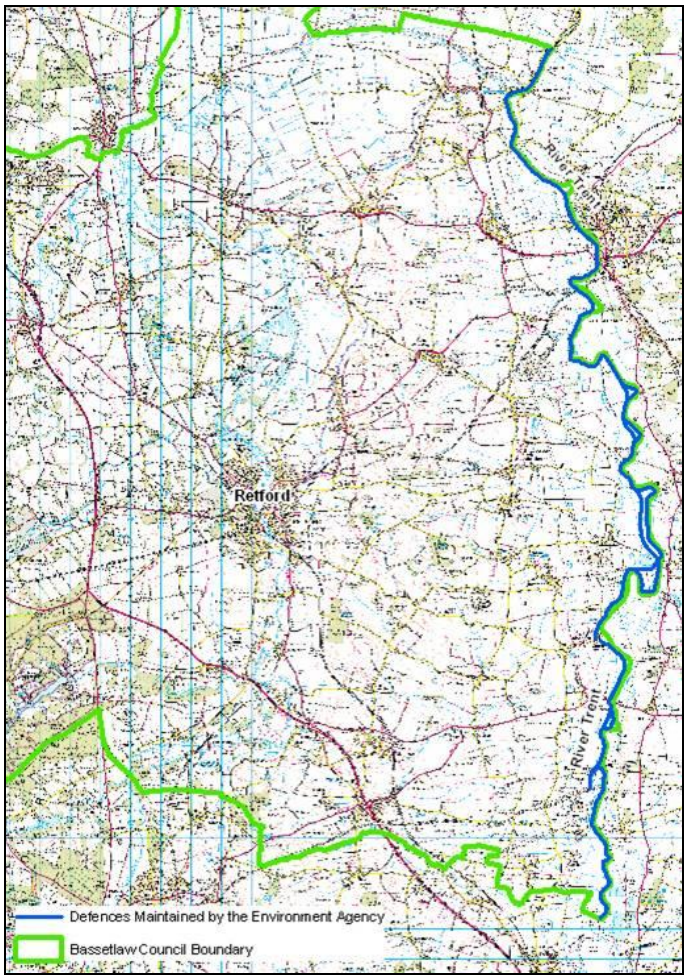
An extract from the Environment Agency's National Flood and Coastal Defence Database (NFCDD) has been supplied and provides information about existing defences in the area, as well as categorising them by type and providing information on who owns and maintains them (See Volume 3). The NFCDD information did not include details of the current condition of the defences.

The type of flood defences and the levels of protection offered vary. In addition to the defences listed, other features exist, both natural and man made which have the potential to contain or divert flood flows and hence provide an informal defence function.

Flood defences along the River Idle and River Ryton are made up of both formal (ie maintained) and informal (ie not maintained). The River Trent defences in Bassetlaw are maintained by the Environment Agency.

A detailed overview of the flood defences in Bassetlaw is given in Volume 3.

Figure 4-2: NFCDD EA maintained defences on the River Trent within Bassetlaw



Areas Benefiting from Defences (ABDs) are defined as those areas which benefit from formal flood defences in the event of flooding from rivers with a 1 in 100 year chance in any given year. Villages alongside the River Trent benefit from the protection of defences.

The River Trent CFMP outlines future policy for flood defences within the Bassetlaw district. This is detailed in Section 3.2.

4.5 Hydraulic Modelling

A summary of hydraulic models used and what they have been used for is shown below:

4.5.1 River Idle Flood Risk Mapping Study (March 2005)

This study was carried out by Jeremy Benn Associates Ltd for the Environment Agency and has been used within the SFRA. The 25 year outlines generated from this river model have been used as functional floodplain for the purposes of the SFRA. The 100 year defended outline has been used within the District and further 1 dimensional modelling undertaken to generate the 100 year with climate change defended outline and the 1000 year defended outline. The model was also used as the starting point for the 2d TUFLOW modelling conducted as part of this SFRA, which produced more accurate 1 in 100 year flood outlines and 1 in 100 year flood outlines with climate change within Retford.

As part of the River Idle Study a breach analysis was carried out using JFLOW software to establish the impact upon the villages of Misson and Mattersey and this information is included in the report.

4.5.2 Tidal Trent Strategy (July 2005)

This study was undertaken by Black & Veatch Consulting Ltd for the Environment Agency. The Trent river model was used as the starting point for the 2 dimensional JFLOW modelling conducted as part of this SFRA, which produced indicative flood outlines during overtopping and breach of the Trent defences.

4.5.3 River Ryton Flood Risk Mapping Study (March 2008)

This study was undertaken by Jeremy Benn Associates Ltd for the Environment Agency and has been used within the SFRA. The 20 year outlines generated from this river model have been used as functional floodplain for the purposes of the SFRA. The 100 year, 100 year plus climate change and 1000 year defended outlines have been used across the district. The model was used as the starting point for the 2d TUFLOW modelling conducted as part of this SFRA, which produced more accurate 1 in 100 year flood outlines and 1 in 100 year flood outlines with climate change within Worksop.

4.6 Topographical Data

The essential dataset required for flood modelling and mapping is a ground model or Digital Elevation Model (DEM). The main source of DEM data for Bassetlaw is LiDAR (Light Detection and Ranging) data, however there were locations adjacent to the Trent where this was not available and therefore NEXTMap was also used in these locations, as shown in Table 4-3.

Table 4-2: DEM Availability

Data type	Owner	Resolution	Filtering	Coverage of Bassetlaw
NEXTMap SAR	JBA	5m	Filtered	100%
LiDAR	Environment Agency	2m	Filtered and unfiltered	60%

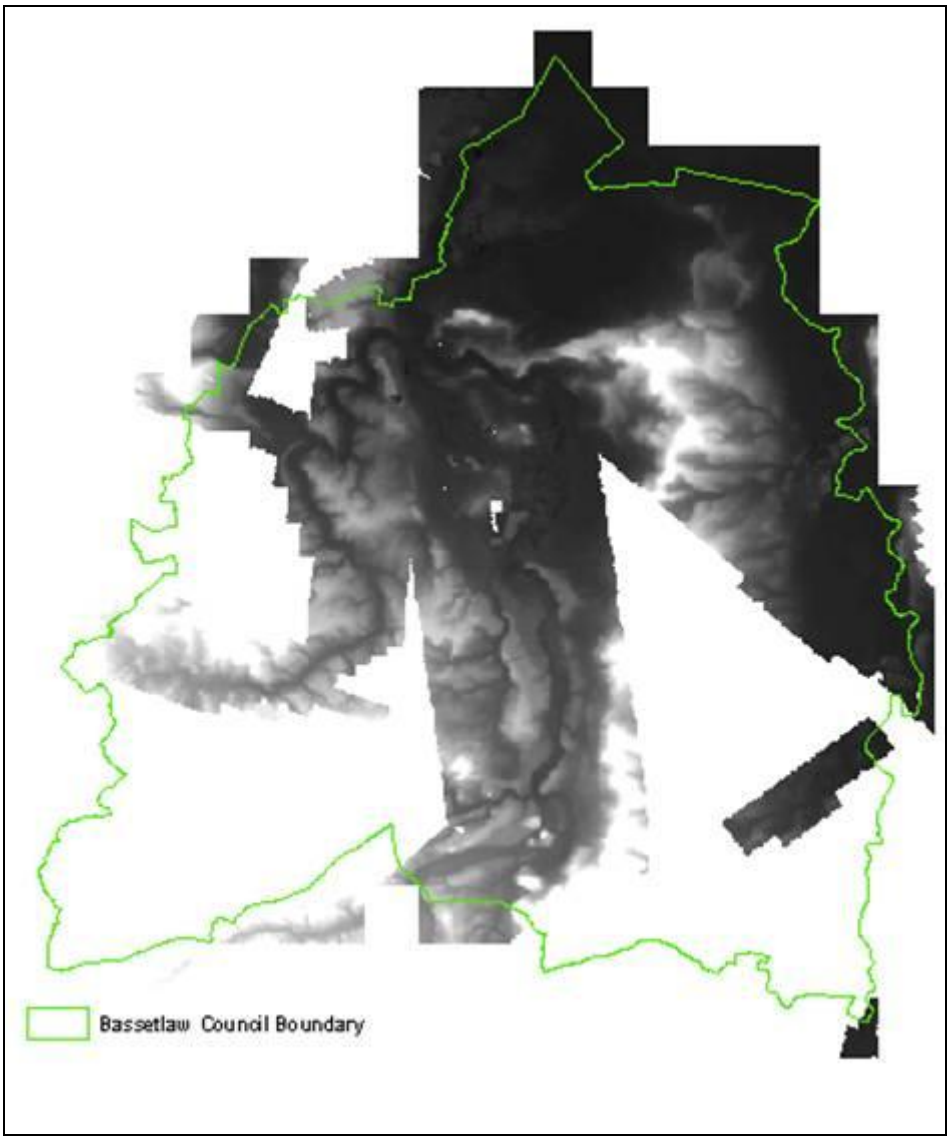
LiDAR data is used in preference to the NEXTMap data as it has a higher vertical accuracy. Both LiDAR and NEXTMap are more accurate on flat ground the degree of accuracy decreases substantially for vegetated and built areas. Inaccuracies are reduced by a process of filtering.

Filtered LiDAR data was provided by the Environment Agency and trimmed to remove land outside the Bassetlaw boundary that was not required for this study.

The null values (holes in the LiDAR or areas of no data) were filled using data interpolation. The LiDAR survey records the top of bridges and embankments. In some areas, it was necessary to "puncture" lower levels through high ground, where there was known to be a possible flow route underneath. The introduction of flow routes through higher ground was based on site visits and consultation with the EA and BDC.

The current coverage of LiDAR data in Bassetlaw is shown in Figure 4-2. The LiDAR is shown in grey, with the lower land being a darker shade of grey and the higher land being a lighter shade.

Figure 4-3: LiDAR Digital Elevation Model - Coverage for Bassetlaw

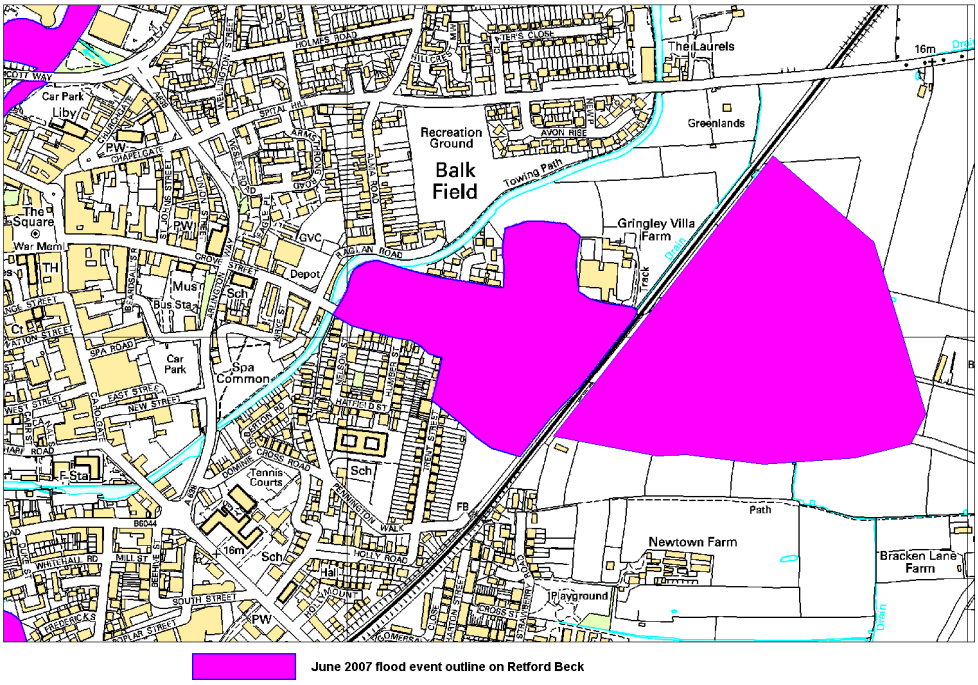


4.7 History of Flooding

Recorded historical flood events in Bassetlaw from rivers are spread throughout the majority of the year, although there is a significant number that have occurred during the months of July to September. Severe floods have affected parts of Bassetlaw in 1922, 1932, 1958, 1964 and 2007; however, information on these events is sparse except for the recent June 2007 event.

The River Ryton flooded in June 2007, overwhelming the existing flood alleviation measures and damaging 273 properties in Worksop, of which 130 properties were residential, while the River Idle broke its banks in a few locations within Retford and Ordsall. Flooding of Retford Beck also impacted upon a number of properties.

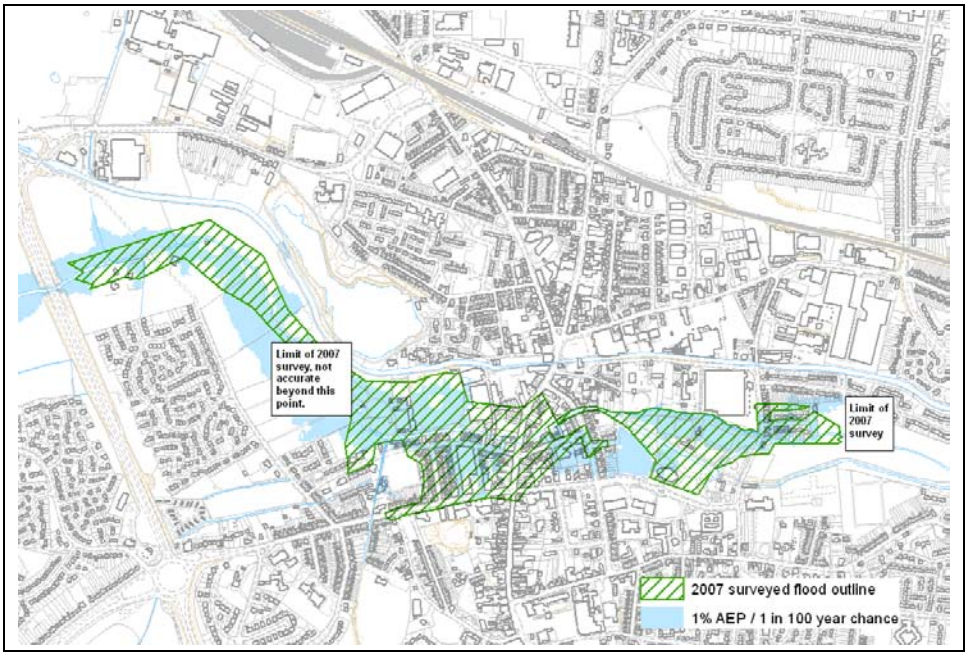
Figure 4-4: Retford Beck June 2007 Flood Outline



There are many uncertainties in the estimated flow of the 2007 flood event and therefore pinpointing a return period on the flood is difficult. Estimates in other reports have varied from a 1 in 150 year annual chance flood to somewhere between a 1 in 100 to a 1 in 300 year annual chance flood.

BDC Engineers and the EA provided surveyed flood outlines of the 2007 flood. These were compared with the modelled flood outlines. An example is shown in Figure 4-5 and the full drawings for Worksop and Retford are included in Volume 4.

Figure 4-5: Worksop surveyed and modelled flood outlines



BDC Engineers and the Rivers Idle & Ryton IDB also provided information on flooding issues relating to smaller drains and from sewers and these are annotated on the maps contained within the SFRA.

The surveyed flood outlines were used to corroborate or highlight inconsistencies in the modelled outlines, which would be expected to remain either entirely inside or entirely outside the surveyed flood outlines. Where inconsistencies were found checks were carried out on the accuracy of the survey and modelling and adjustments made where necessary.

Severn Trent Water (STW) provided a register of recorded flooding from sewers within Bassetlaw and this has been used to prepare the All Sources Flood Risk maps. The STW register is a live document, updated should further flood incidents be recorded, and was correct at December 2008.

4.8 Limitations of Background Information

The data used in the SFRA is limited in some aspects and it is important that these limitations are considered.

The Environment Agency's Flood Zone maps are based on generalised river modelling only and are limited by way of not including all minor watercourse floodplains or the effects of any defences. The Flood Zone maps are produced from a national mapping project and provide flood zone mapping from the points where river catchments reach an area of 3km^2. Therefore, for any site (including those below 1ha) adjacent to an unmapped watercourse, a site-specific FRA will be required to establish the true floodplain extent and flood risk to the development site.

Where there is no reference to localised flooding issues at a site, this does not necessarily mean that there are none; records may not have been available to inform this SFRA.

Limitations of the existing river modelling studies used in the report should be acknowledged due to the nature of flood risk mapping, estimation of catchments and hydrology. Watercourse surveys, changes since the studies, new developments, additional structures and constraints, seasonal variations in the roughness of watercourse channels due to growth of vegetation and maintenance of the channel will all have an effect on the flood risk. The outlines for the River Ryton and Idle have been taken directly from existing river model studies. With the exception of the Retford Beck, where a new river model was built specifically for this SFRA, existing river modelling studies formed the starting point for all 2d modelling carried out as part of the level 2 assessment of flood risk

Limitations associated with the use of LiDAR and NEXTMap data must be acknowledged. Both LiDAR and NEXTMap are more accurate on flat ground, but the degree of accuracy decreases substantially for vegetated and built up areas. Inaccuracies are reduced by a process of filtering. It is essential to cross reference against surveyed level information where this is available and against Ordnance Survey and site visits to allow for flow routes under bridges or embankments which would not be picked up by the aerial surveys.

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5 LEVEL 2 ASSESSMENT OF FLOOD RISK

5.1 Introduction

This section contains information and guidance on the outputs of the Level 2 SFRA. A technical overview which provides further detailed information on the creation of the outputs described in this section is provided in Volume 3.

The level 2 assessment of flood risk goes beyond the Environment Agency Flood Zone Map and utilises more detailed hydraulic modelling techniques. The Level 2 assessment includes:

- An assessment of flood risk with flood defences in place;
- An assessment of flood risk resulting from a failure or breaching of a flood defence;
- The possible extent of surface water flooding in extreme rainfall events; and
- Flood hazard mapping in relation to water velocity and depth in Worksop and Retford.

The following maps have been produced as part of the SFRA in order to delineate the flood zone outlines and establish, in key areas, the variation of risk within the flood outlines:

- **Flood Zone Maps:** These are provided for the whole of Bassetlaw district. They include the latest Environment Agency Flood Zone 3 (100 year) and Flood Zone 2 (1000 year) outlines, which have been generated using broad scale modelling techniques and do not include the effect of any defences. They should be used as the starting point for application of the Sequential and Exception Tests for all areas within Bassetlaw district. The maps have been annotated to show where more detailed modelling is available, referring the user to the Defended Outline Maps in these areas.
- **Defended Outline Maps:** These maps show the defended flood outlines where available for the District. Outlines for the Rivers Idle and Ryton have been created using 1 dimensional river modelling techniques. The 20/25 year (Flood Zone 3b), 100 year (Flood Zone 3a), 100 year with climate change and 1000 year (Flood Zone 2) flood events are shown. Defended outlines for the River Trent have been created using 2 dimensional JFLOW modelling. These maps should be used in accordance with the instructions on the Flood Zone Maps. They will form the starting point for application of the Sequential and Exception Tests for areas adjacent to the Rivers Idle, Ryton and Trent. They are annotated to show where more accurate 2 dimensional modelling is available in the towns or Worksop and Retford, referring the user to the Flood Dynamic Maps in these areas.
- **Flood Dynamic Maps:** These maps show the defended flood outlines for the 20/25 year (Flood Zone 3b), 100 year (Flood Zone 3a), 100 year with climate change and 1000 year (Flood Zone 2) flood events for the Rivers Idle and Ryton within Worksop and Retford. The 100 year and 100 year with climate change outlines have been generated using 2 dimensional river modelling techniques, which are more accurate than 1 dimensional methods. The maps give an indication of the causes and severity of flooding, displaying details of the flood flow direction and the typical depth of flooding during a 100 year annual chance event. These maps should be used where instructed on the Defended Outline Maps. They will form the starting point for application of the Sequential and Exception Tests in areas adjacent to the River Ryton in Worksop and adjacent to the River Idle in Retford.

- **Depth Maps:** These maps are provided for the River Ryton in Worksop and River Idle in Retford, based on the 2 dimensional modelling. They show the variation in flood depth across the 100 year (Flood Zone 3a) defended outline. In addition, they show the extended flood outline where a breach in defences has been modelled. They should be used to inform the application of the Exception Test adjacent to these rivers in Worksop and Retford.
- **Hazard Mapping:** These maps are provided for the River Ryton in Worksop and the River Idle in Retford, based on the 2 dimensional modelling. The maps give details of the degree of flood hazard within the 100 year and 100 year with climate change defended outlines. The hazard rating is dependent on flood depth and velocity and has been calculated according to the methodology given in the DEFRA report FD2320. Four hazard categories are displayed – very low hazard, danger for some, danger for most and danger for all. They should be used to inform the application of the Exception Test adjacent to these rivers in Worksop and Retford.
- **Standard of Protection Maps:** These maps detail the standard of protection provided by existing flood risk management infrastructure (ie: flood defences) along the River Ryton in Worksop and Idle in Retford. The outlines shown are the same as the Flood Dynamic Maps but they give more information on the defences and infrastructure which affects flood flow. They should be used to inform the application of the Exception Test adjacent to these rivers in Worksop and Retford.
- **Trent Breach Maps:** These maps demonstrate the effects of failure of the Trent defences. The outlines have been produced using 2 dimensional JFLOW modelling. They should be used to inform the application of the Exception Test in areas adjacent to the Trent.
- **Canal Breaches:** These maps detail the effects of a simulated failure of a canal embankment. They should be used to inform the application of the Exception Test in Worksop and Retford.
- **Non-Fluvial Flood Risk Maps:** These maps show indicative flooding caused by surface water run off during an extreme (1 in 200 year) rainfall event, assuming sewer networks are full to capacity. The surface water flooding is categorised according to its depth and associated risk. The maps also highlight areas where instances of sewer flooding have been recorded. The maps should be used to inform Flood Risk Assessments.

5.2 Assessment of Flood Risk in Worksop

5.2.1 Fluvial Flood Risk

The River Ryton flows West to East through Worksop, with few formal flood defences. Much of the Ryton is culverted beneath the town centre which can create restrictions to flows during large flood events. Flooding from the River Ryton during the summer floods of 2007 caused extensive damage in Worksop.

Figure 5-1: Fluvial Flood Risk in Worksop

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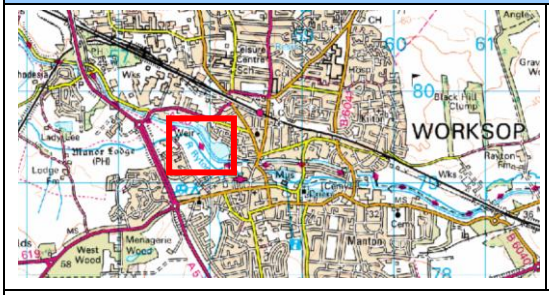
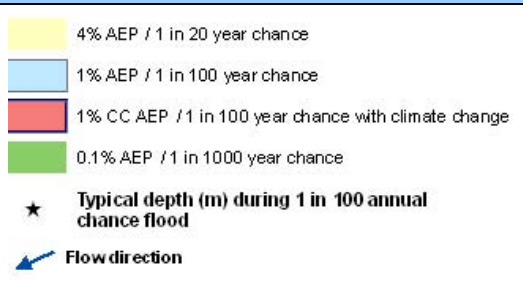
Vicinity of:	**Key Points:**
Stubbing Lane	• Wide functional floodplain (Flood Zone 3b) on open land along river corridor. • 100 yr flood depth varies up to approx 0.75m • Danger for some / most • Flood risk associated with tributaries
Cricket Ground Bus Station Central Avenue	• Extensive flooding. • Depth varies up to approx 0.5m deep / 0.75m deep with climate change. • Affects existing properties, cricket club and caravan park. • Flood water overtops walls at rear of properties on Central Avenue and flows towards town centre. • Danger for some. Danger for most with climate change. • Flood risk associated with tributaries
Town Centre Ryton Street	• Existing property and highway flooding. • Mostly originates from Central Avenue direction. • Depth varies up to approx 0.5m deep. • Mostly Low Hazard.
Library Canch Recreational Ground	• Functional floodplain (Flood Zone 3b) extends across recreational ground. • 100 yr flooding affects land adjacent library and car park. Originates from town centre. • 100 yr depth approx 0.3m. Mostly low Hazard.
Shelley Street	• Low hazard shallow flooding along Shelley Street flows back into Ryton. • Exacerbated during 2007 flood by wall along bottom which trapped flood water
Downstream of High Hoe Road and Disused Sewage Treatment Works	• Wide functional floodplain (Flood Zone 3b) on open land to north of Ryton. • 100 yr Approx 0.5m deep • 100 yr Danger for most • Existing foul sewers may be inundated with flood water leading to sewage overflow into river. • Flooding unlikely to extend southwards beyond canal

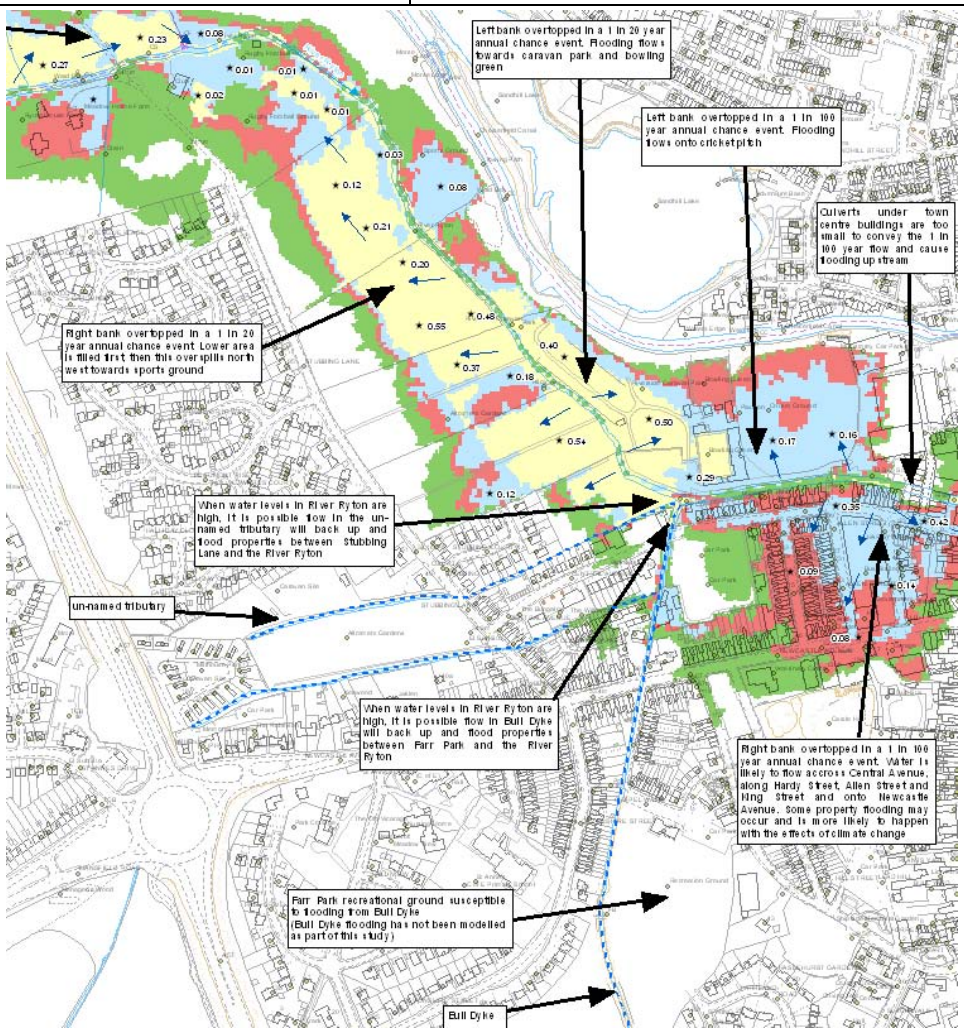
5.2.2 Worksop Flood Dynamic Maps

The following example flood dynamic map shows defended flood outlines for the River Ryton in Worksop. Four possible flood events have been examined: 5% or 1 in 20 year event, 1% or 1 in 100 year event, 1% or 1 in 100 year event with climate change and a 0.1% or 1 in 1000 year event. The 1 in 20 year outline represents the functional floodplain or Flood Zone 3b, 100 year Flood Zone 3a and 1000 year Flood Zone 2. The maps include reported flooding problems and information on the causes of flooding. The full maps can be found in Volume 4 and are intended to inform the Sequential and Exception Tests

Figure 5-2: Worksop Flood Dynamic Map



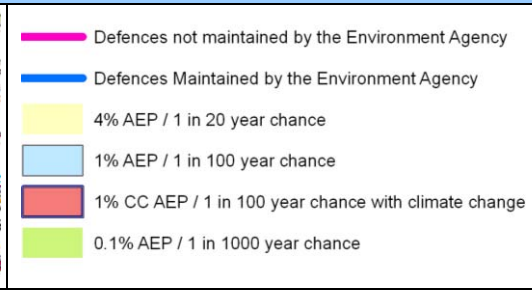


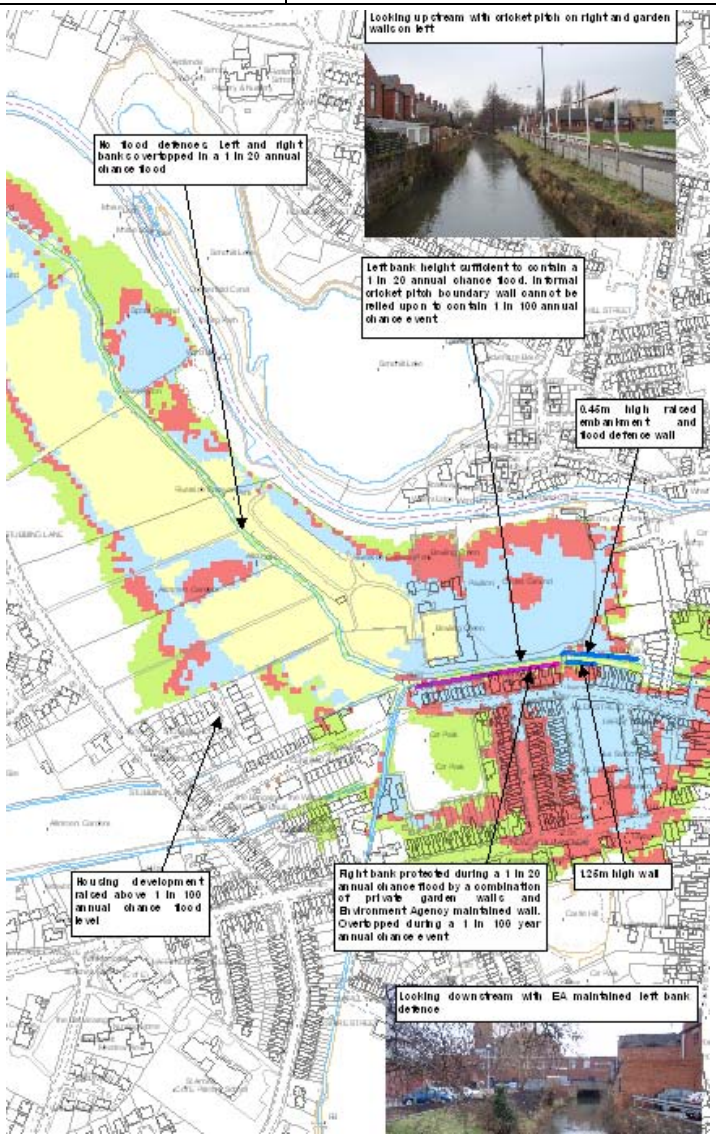


5.2.3 Worksop Standard of Protection Maps

The following is an example of a standard of protection map for Worksop describing the current flood defence infrastructure, both formal and informal. There are few formal defences in Worksop and they do not have a considerable effect on flood outlines in Worksop. Current Environment Agency information on the condition of defences is limited. The full maps can be found in Volume 4 and are intended to inform the Sequential and Exception Tests

Figure 5-3: Worksop Standard of Protection Map

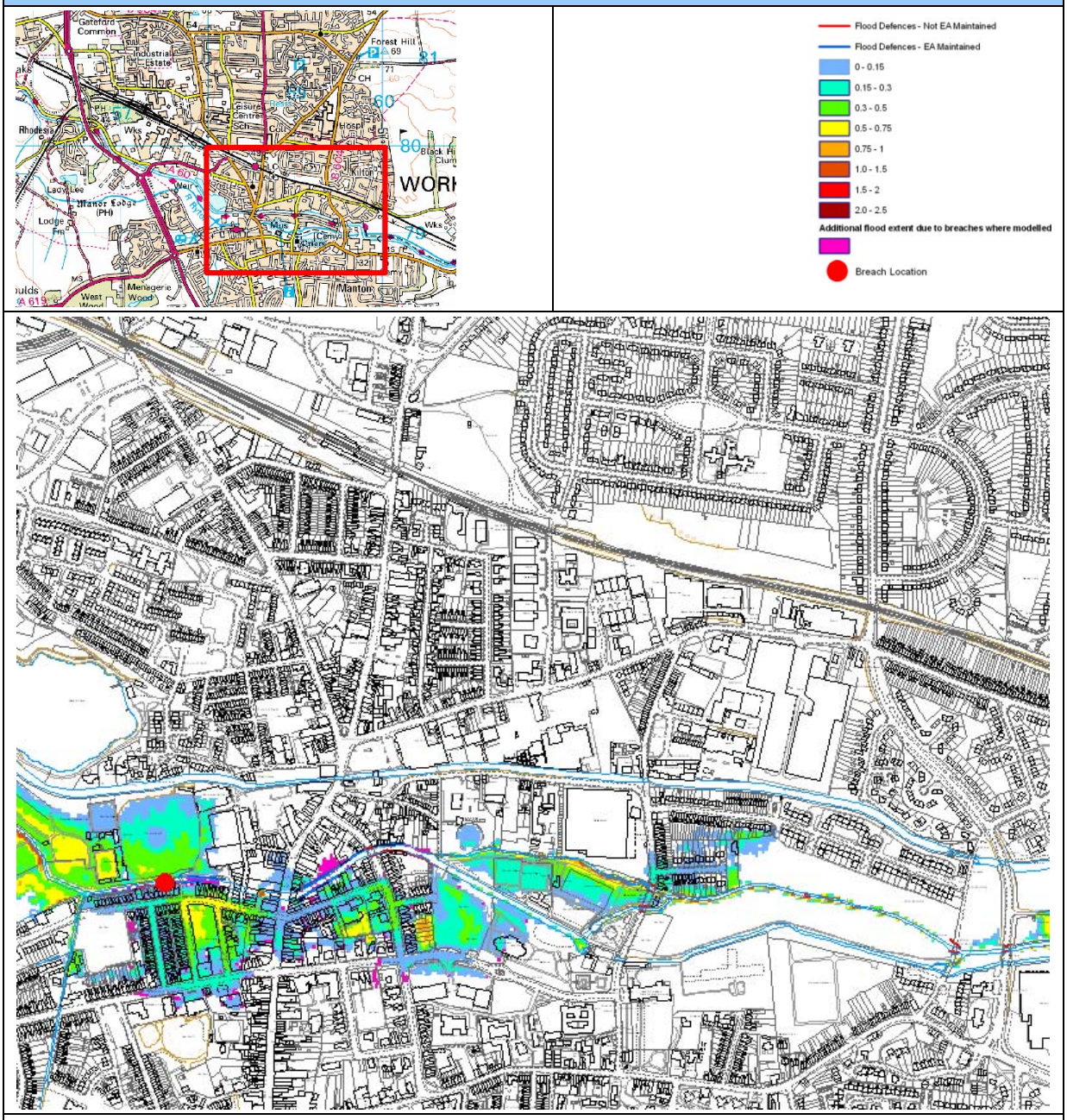




5.2.4 Worksop Depth Maps

The following is an example of a flood depth map for Worksop, created using 2D modelling. The maps display the variation in flood depth within the 100 year (Flood Zone 3a) and 100 year with climate change defended flood outlines. The full maps are included in Volume 4 and are intended to inform the Sequential and Exception Tests.

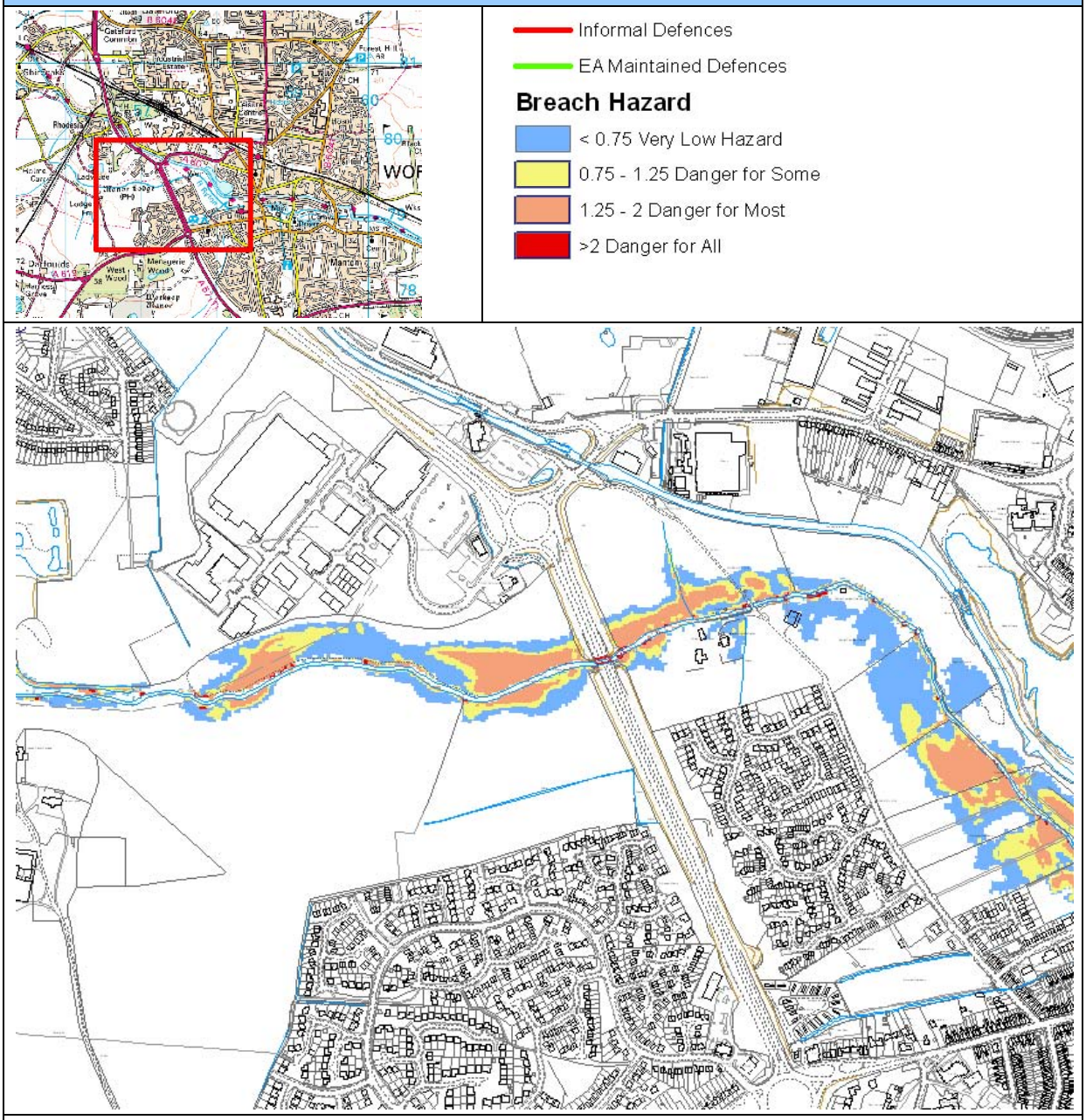
Figure 5-4: Worksop Flood Depth Map (100yr with Climate Change Scenario)



5.2.5 Worksop Hazard Maps

The following is an example of a hazard map for Worksop. The full maps are contained in Volume 4 and have been produced in accordance with the current Defra guidance report FD3230. The hazard rating takes into account the depth of flooding and the speed or velocity of the flow, which have been derived from 2D modelling of flood defence breach and overtopping for both 100 year and 100 year with climate change flood scenarios. The maps demonstrate the variation of fluvial flood risk within Flood Zone 3 and are intended to inform the Sequential and Exception Tests.

Figure 5-5: Worksop Hazard Map (100yr Scenario)



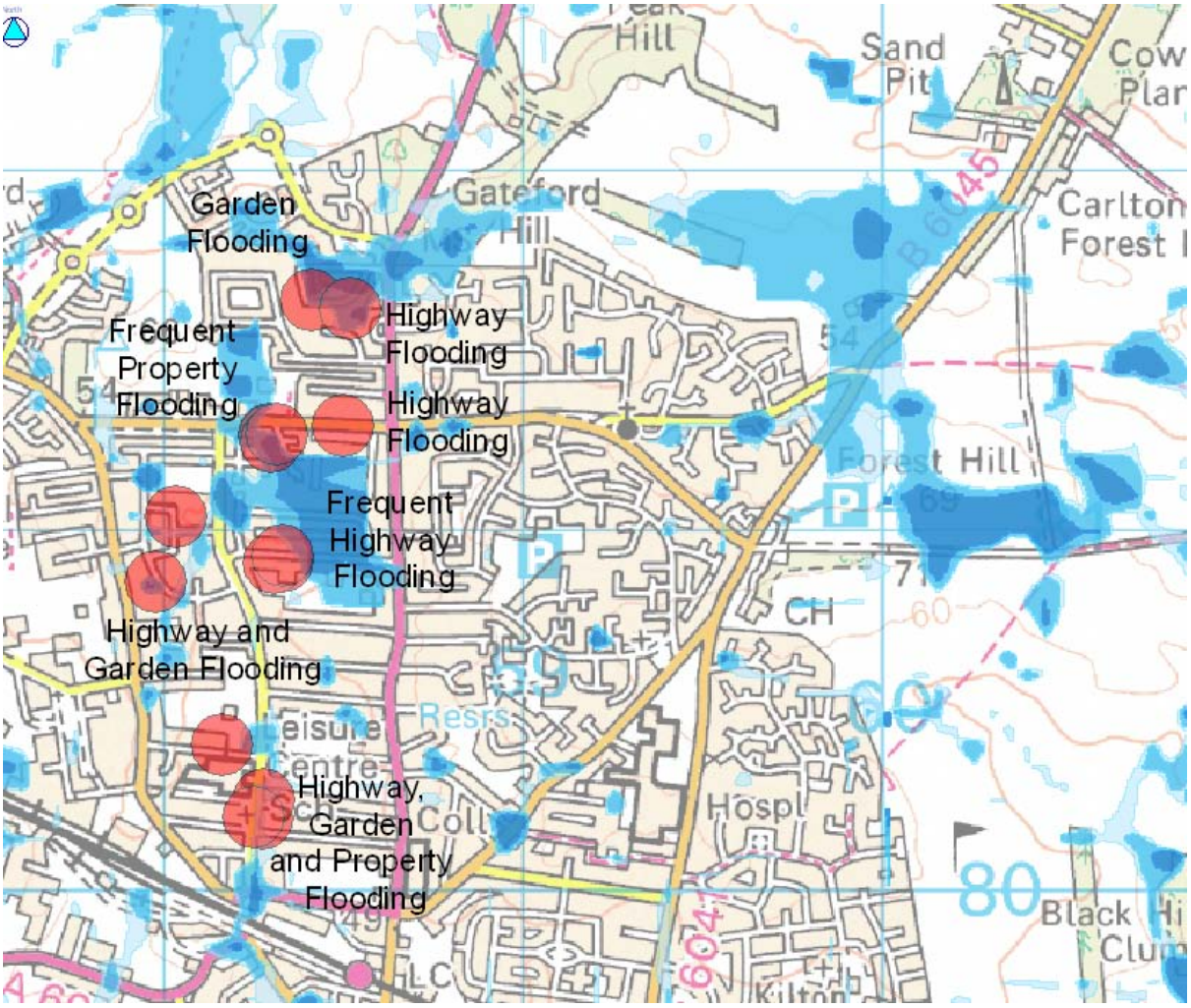
5.2.6 Worksop Non-Fluvial Flood Risk

The following is an example map showing flood risk in Worksop from sources other than fluvial flooding. Other sources of flooding include groundwater, possible overland flow during extreme rainfall and flooding from surcharged under-capacity or blocked sewers. The full maps are included in Volume 4.

Key Points:

- Surface water maps show the effects of a 1 in 200 yr chance rainfall event assuming all sewer systems are full to capacity. Flood outlines highlight areas where water is prone to collect and thus highlights the need for further consideration during development planning.
- Sewer flooding records were provided by Severn Trent
- Areas of past recorded sewer flooding highlight the need for further investigation only – the map is not aimed to preclude all future development at these locations.
- Flood Risk Assessments for development in areas at "more risk" of surface water flooding should pay particular attention to run-off from surrounding areas. The development proposals should be shown not to be at risk of flooding in a 100 yr + climate change rainfall event.
- Flood Risk Assessments and Drainage Impact Assessments should make reference to the recorded sewer flooding incidents. The proposals should be shown not to be at risk of flooding from sewers. Development proposals should be shown not to exacerbate any existing sewer capacity problems.

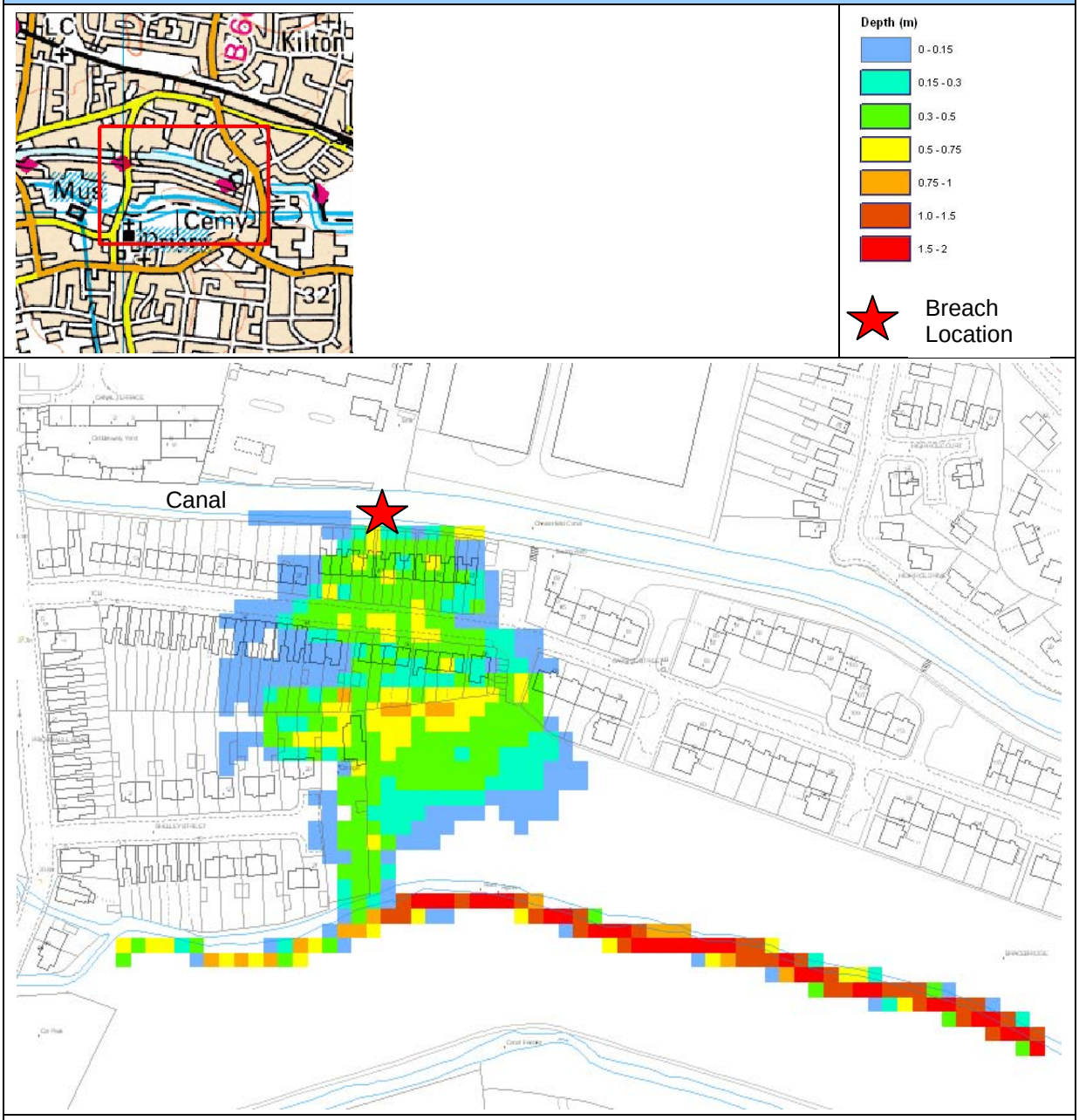
Figure 5-6: Worksop Non-Fluvial Flood Risk Map



5.2.7 Canal Embankment Breaching

The following canal embankment breach map displays the possible effects of the failure of a canal embankment in Worksop. The notional location used as an example is not considered to be more at risk than other locations where the canal is elevated above surrounding ground levels. British Waterways have been consulted as part of this SFRA and have reported no problems due to breaches or leakage from the canal. Potential flood risk due to elevated canal pounds should be considered in the application of the Sequential and Exception Tests and in site specific Flood Risk Assessments.

Figure 5-7: Worksop Canal Breach

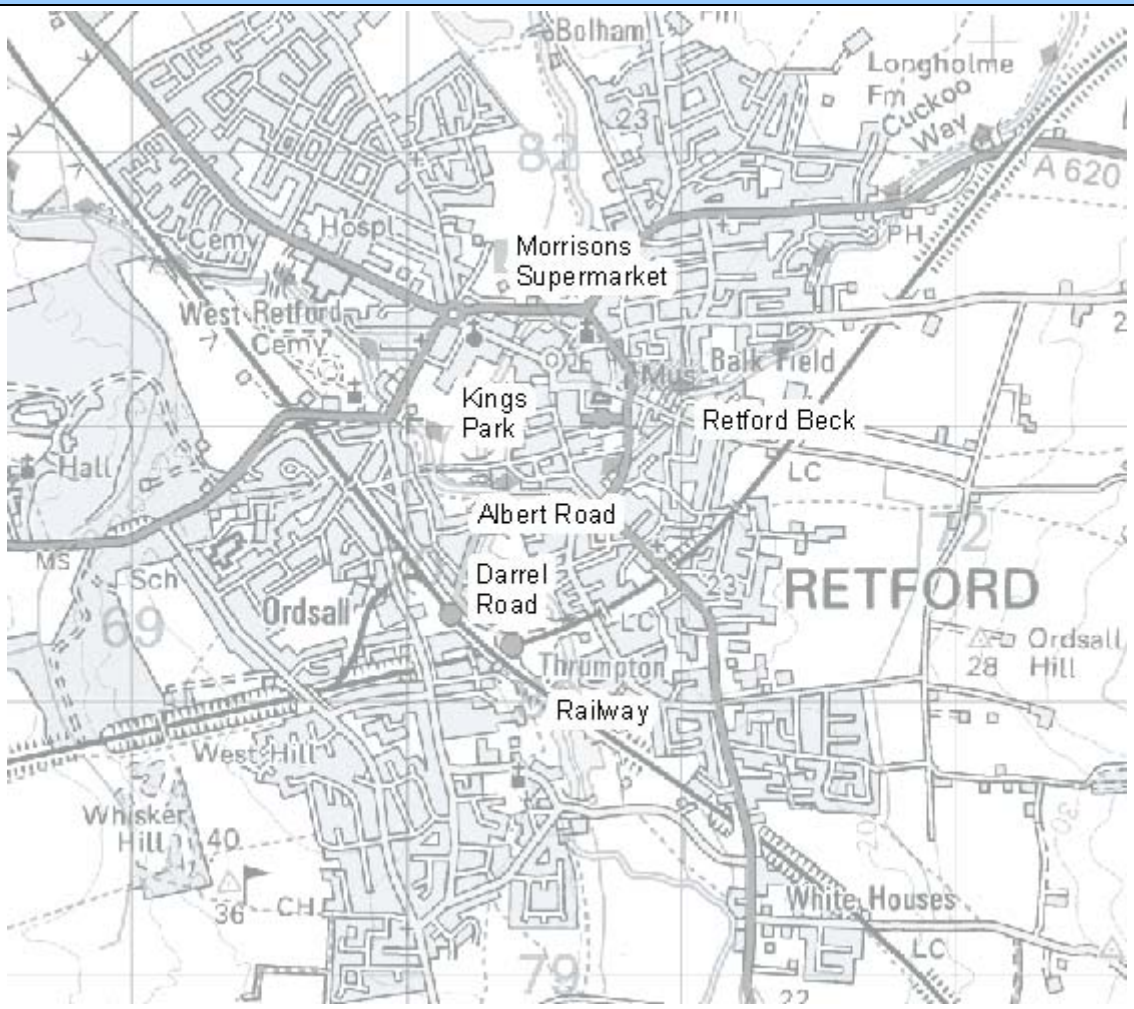


5.3 Assessment of Flood Risk in Retford

5.3.1 Fluvial Flood Risk

The River Idle flows South to North through Retford. Existing flood alleviation schemes are in place however there are few formal defences. Retford Beck joins the Idle in Retford. The Beck is heavily culverted and is known to cause flooding problems due to undersized culverts.

Figure 5-8: Fluvial Flood Risk in Retford



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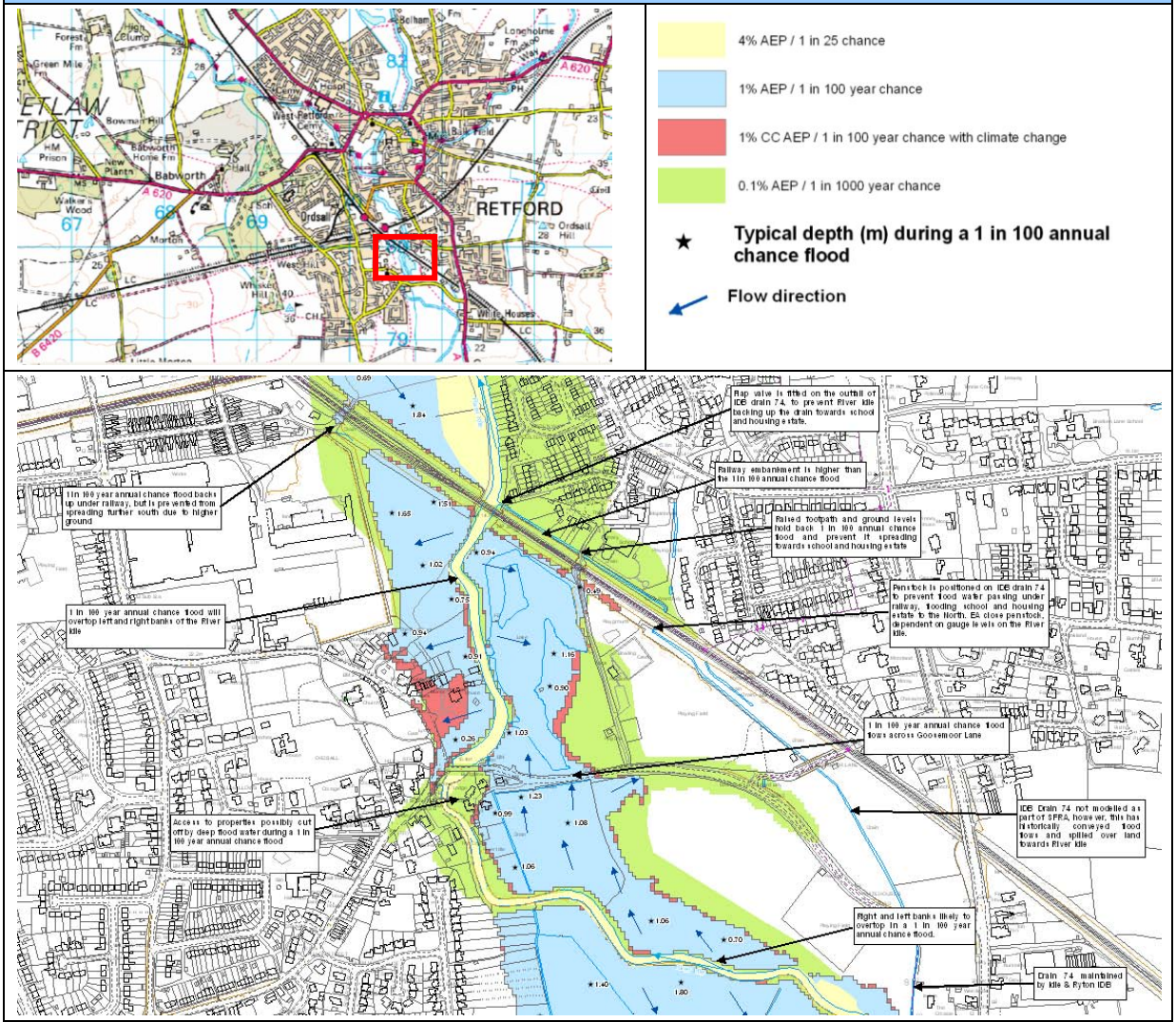
Vicinity of:	**Key Points:**
Upstream (south) of railway	• Functional floodplain is in bank or close to the river channel • 100 yr flooding spreads widely both sides of the river • 100 yr flood depth approx 1.0 – 1.5m. • 100 yr flood is generally Hazard for most. Hazard for all immediately upstream of railway. • Flood risk associated with IDB drains should be considered in site specific Flood Risk Assessments • Flaps on IDB drains prevent flood water spreading further • Mounded footpath prevents 100 yr flood water spreading further beneath railway
Between Railway and Albert Road	• 25 yr (functional floodplain) remains in bank • Culvert beneath Albert Road is too small to convey 100 yr flows • Carr Dyke creates route for 100 yr flood beneath Albert Road and canal • Informal walls protect houses on Darrel Road • 100 yr flood depths approx 1.5m. Flood extent and depth likely to increase slightly with climate change. • 100 yr flood generally hazard to most
Kings Park	• 25 yr (functional floodplain) remains in bank • 100 yr flood spreads widely on both sides of the River Idle affecting some existing properties on the perimeter. Flood extent and depth likely to increase slightly with climate change. • 100 yr depths vary, up to 1.5m in Kings Park. Generally Hazard to most in Kings Park. • 100 yr flooding to properties is shallower and mostly low hazard
Between Kings Park and Morrisons Supermarket	• 25 yr (functional floodplain) remains in bank • 100 yr remains mostly in bank but with climate change flooding likely to flow across car park onto Churchgate and Moorgate, towards Waterfields and Water Lane. 100 yr plus climate change flooding on Moorgate likely to be 0.3m – 0.5m deep and classed as hazard to some on this main highway route through Retford.
Downstream (north) of Morrisons Supermarket	• 25 yr flood (functional floodplain) remains in bank • 100 yr flood spreads widely on both sides of the River Idle • 100 yr depths vary considerably, up to approx 1.5m • Areas of shallow, low hazard flooding on some open ground • 100 yr flood with climate change is likely to affect some existing properties
Retford Beck	• Retford Beck is heavily culverted and under-capacity to convey 25 yr flow. • Functional floodplain extends considerably at culvert entrance • 100 yr flood extent is not significantly larger than 25 yr • 100 yr flood depth approx 0.75m

5.3.2 Retford Flood Dynamic Maps

The following example flood dynamic map shows defended flood outlines for the River Idle in Retford. Four possible flood events have been examined: 4% or 1 in 25 year event, 1% or 1 in 100 year event, 1% or 1 in 100 year event with climate change and a 0.1% or 1 in 1000 year event. The 1 in 25 year outline represents the functional floodplain or Flood Zone 3b, 100 year Flood Zone 3a and 100 year Flood Zone 2. The maps include reported flooding problems and information on the causes of flooding. The full maps can be found in Volume 4 and are intended to inform the Sequential and Exception Tests

Figure 5-9: Retford Flood dynamic Map



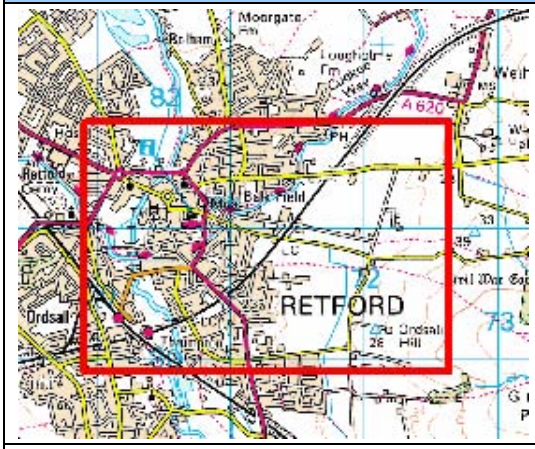
5.3.3 Retford Beck

20 year, 100 year, 100 year with climate change and 1000 year flood events have been modelled to create defended flood outlines.

Key Points:

- Much of the Retford Beck is culverted in a single long culvert beneath the town.
- Culverts on the Beck are too small to convey 20 year flows
- There are no defences on open channel or flood risk management infrastructure
- 20 year (Zone 3b) flood outline is extensive. 100 year (Zone 3a) and 100 year with climate change extend only slightly further than the 20 year flood outline.

Figure 5-10: Retford Beck Map



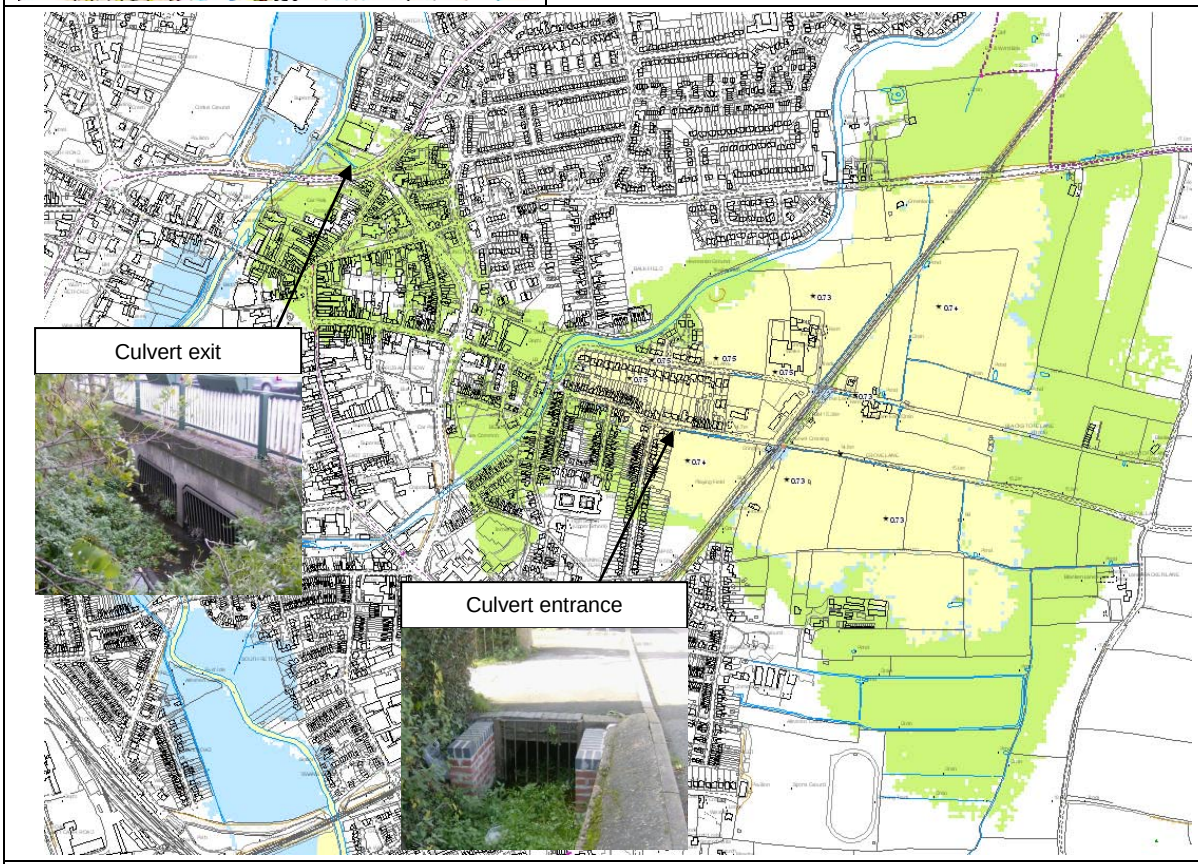
4% AEP / 1 in 20 year chance

1% AEP / 1 in 100 year chance

1% CC AEP /1 in 100 year chance with climate change

0.1% AEP /1 in 1000 year chance

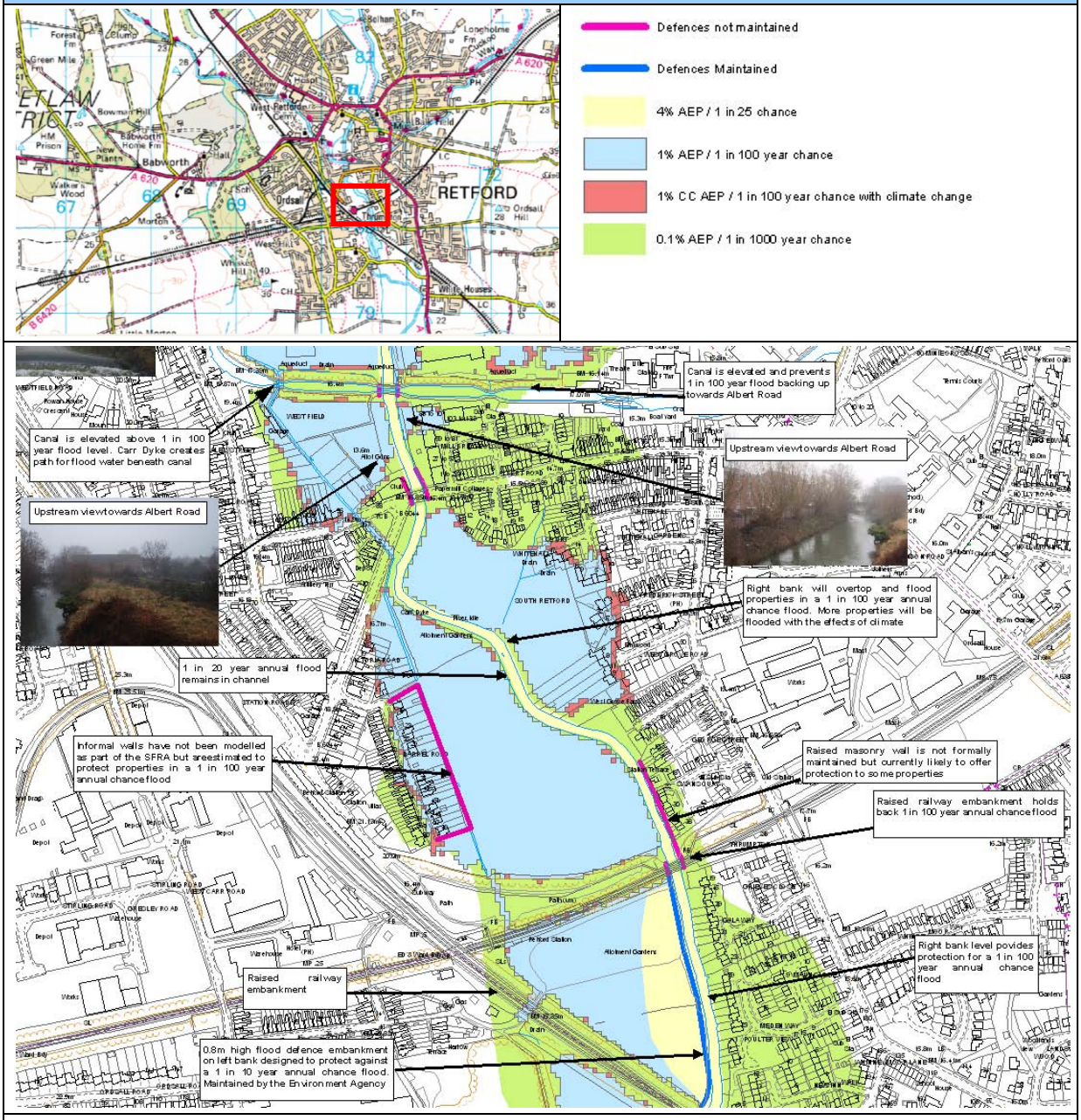
★ **Typical depth (m) during 1 in 100 annual chance flood**



5.3.4 Retford Standard of Protection Maps

The following is an example of a standard of protection map for Retford describing the current flood defence infrastructure, both formal and informal. There are few formal defences in Retford although the channel has been widened to provide capacity in most places for the 25 year flow. The full maps can be found in Volume 4 and are intended to inform the Sequential and Exception Tests

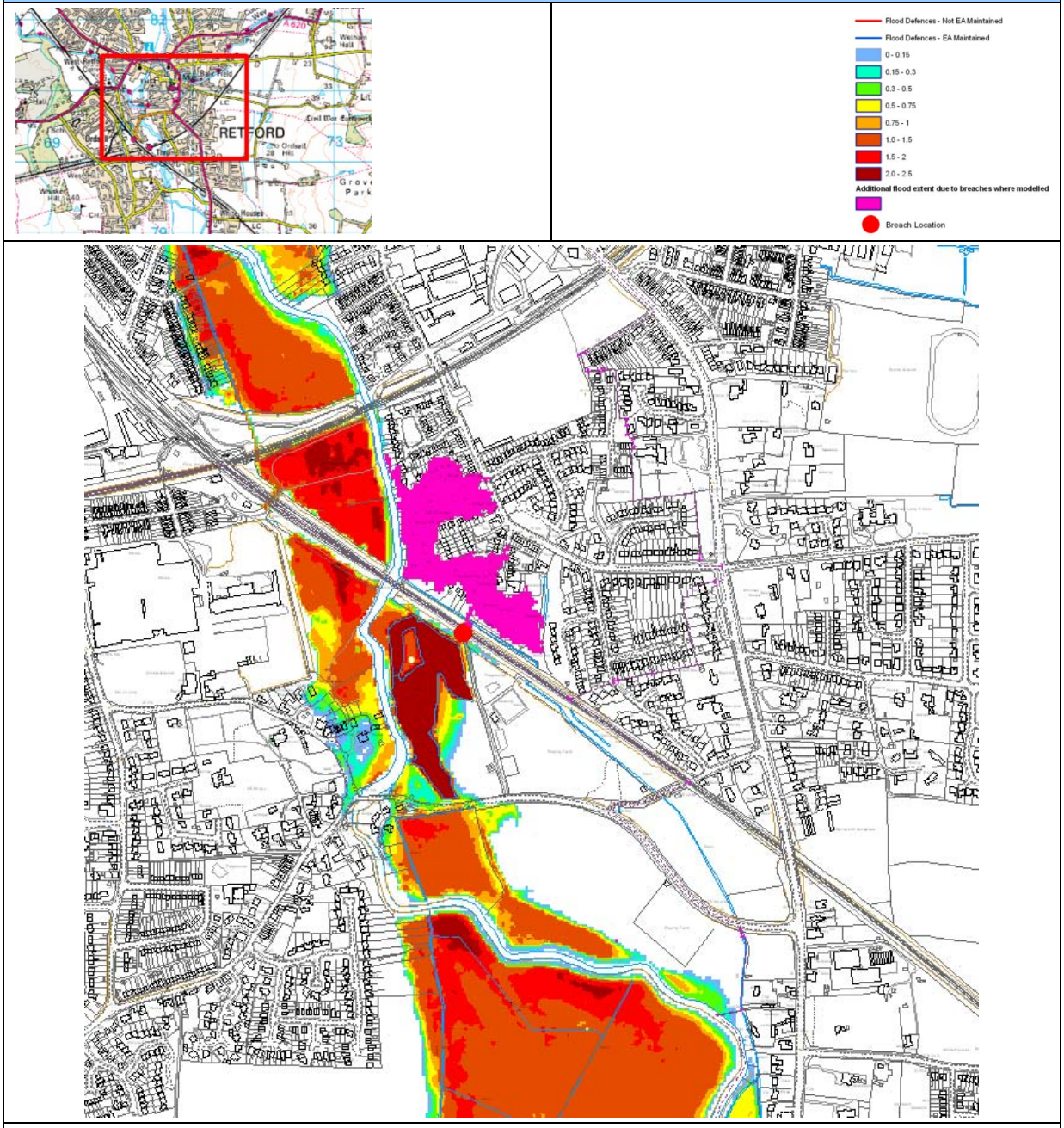
Figure 5-11: Retford Standard of Protection Map



5.3.5 Retford Depth Maps

The following is an example of a flood depth map for Retford, created using 2D modelling. The maps display the variation in flood depth within the 100 year (Flood Zone 3a) and 100 year with climate change defended flood outlines. They also show the possible consequences of defence breaches. The full maps are included in Volume 4 and are intended to inform the Sequential and Exception Tests.

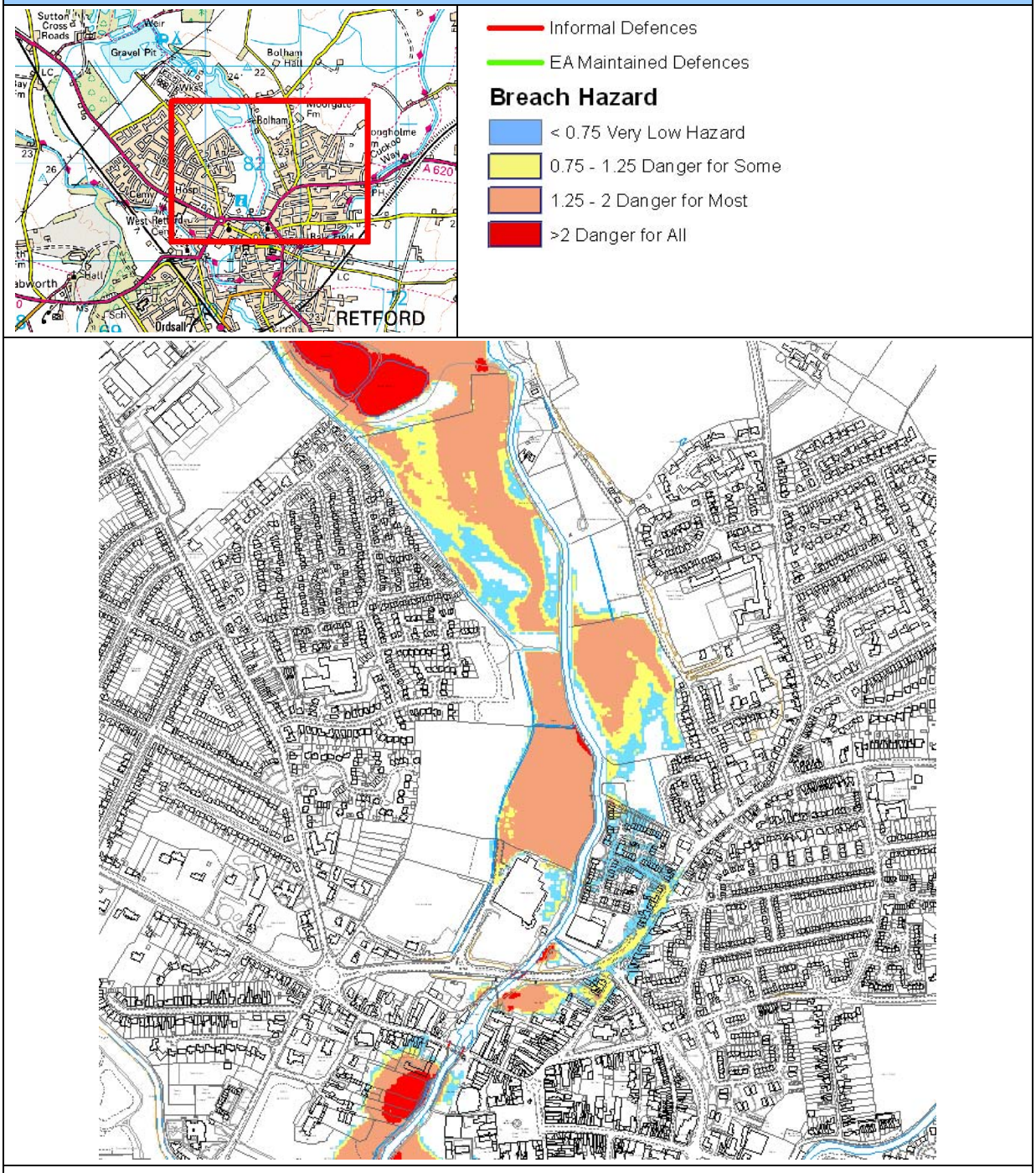
Figure 5-12: Retford Flood Depth Map (100yr with Climate Change Scenario)



5.3.6 Retford Hazard Mapping

The following is an example of a hazard map for Worksop. The full maps are contained in Volume 4 and have been produced in accordance with the current Defra guidance report FD3230. The hazard rating takes into account the depth of flooding and the speed or velocity of the flow, which have been derived from 2D modelling of flood defence breach and overtopping for both 100 year and 100 year with climate change flood scenarios. The maps demonstrate the variation of fluvial flood risk within Flood Zone 3a and are intended to inform the Sequential and Exception Tests.

Figure 5-13: Retford Hazard Map (100yr with Climate Change Scenario)



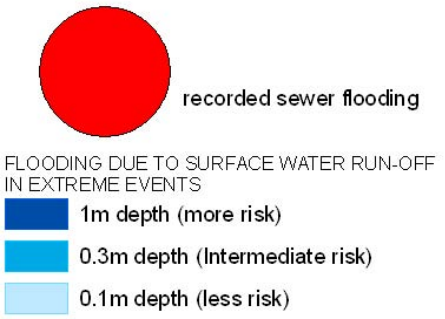
5.3.7 Retford Non-Fluvial Flood Risk Maps

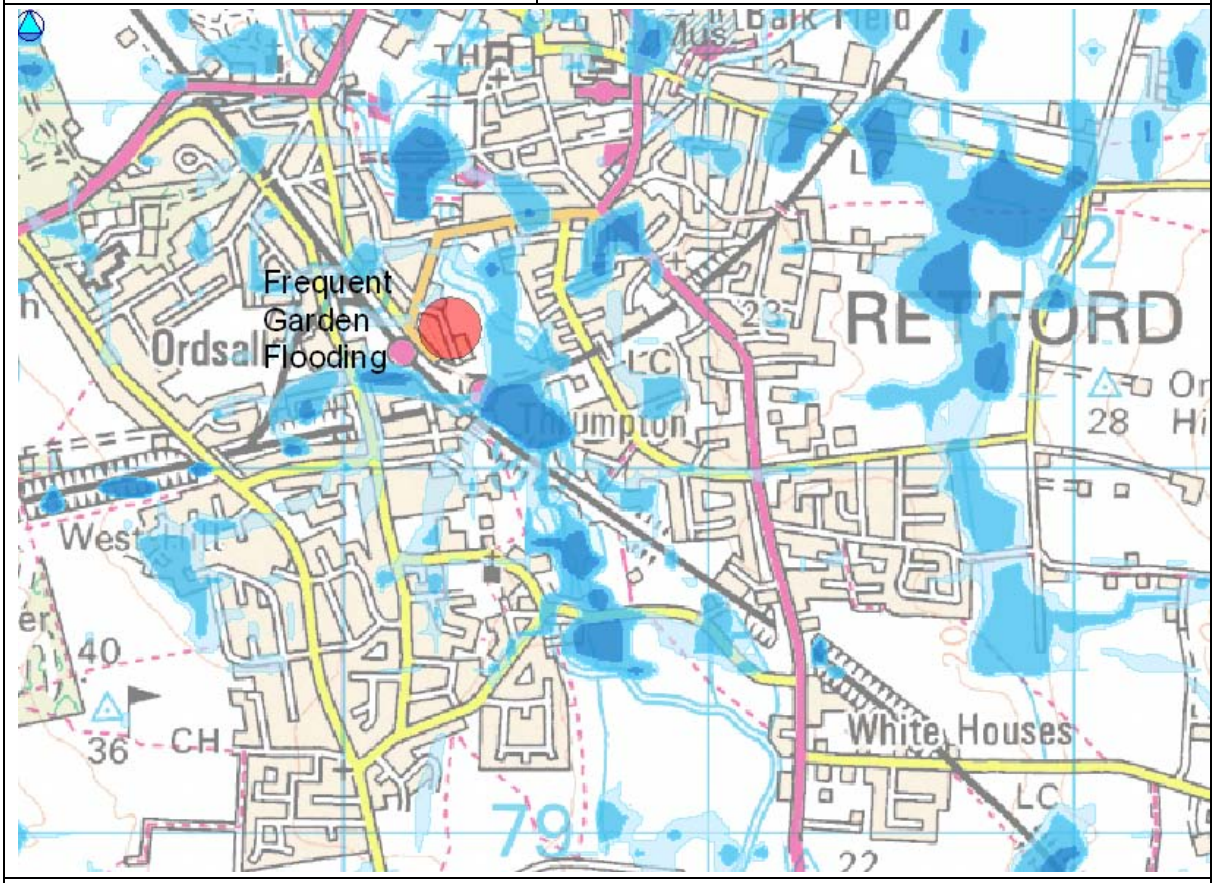
The following is an example map showing flood risk in Retford from sources other than fluvial flooding. Other sources of flooding include groundwater, possible overland flow during extreme rainfall and flooding from surcharged under-capacity or blocked sewers. The full maps are included in Volume 4.

Key Points:

- Surface water flood outlines show the effects of a 1 in 200 yr chance rainfall event assuming all sewer systems are full to capacity. Flood outlines highlight areas where water is prone to collect and thus highlights the need for further consideration during development planning.
- Sewer flooding records were provided by Severn Trent
- Areas of past recorded sewer flooding highlight the need for further investigation only – the map is not aimed to preclude all future development at these locations.
- Flood Risk Assessments for development in areas at "more risk" of surface water flooding should pay particular attention to run-off from surrounding areas. The development proposals should be shown not to be at risk of flooding in a 100 yr + climate change rainfall event.
- Flood Risk Assessments and Drainage Impact Assessments should make reference to the recorded sewer flooding incidents. The proposals should be shown not to be at risk of flooding from sewers. Development proposals should be shown not to exacerbate any existing sewer capacity problems.

Figure 5-14: Retford Non-Fluvial Flood Risk Map

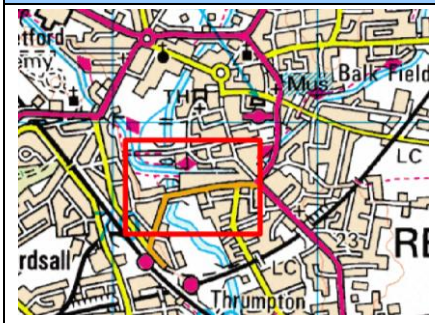


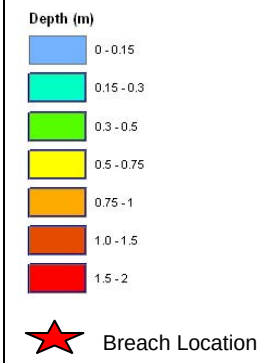


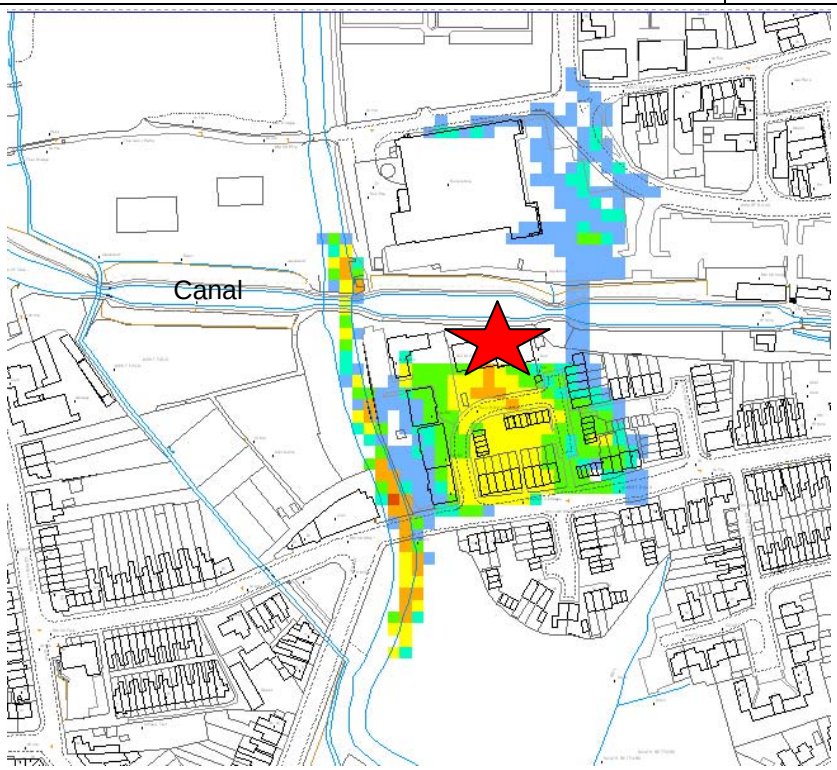
5.3.8 Canal Embankment Breaching

The following canal embankment breach map displays the possible effects of the failure of a canal embankment in Retford. The notional location used as an example is not considered to be more at risk than other locations where the canal is elevated above surrounding ground levels. British Waterways have been consulted as part of this SFRA and have reported no problems due to breaches or leakage from the canal. Potential flood risk due to elevated canal pounds should be considered in the application of the Sequential and Exception Tests and in site specific Flood Risk Assessments.

Figure 5-15: Retford Canal Breach







5.4 Assessment of Flood risk in Bassetlaw Villages

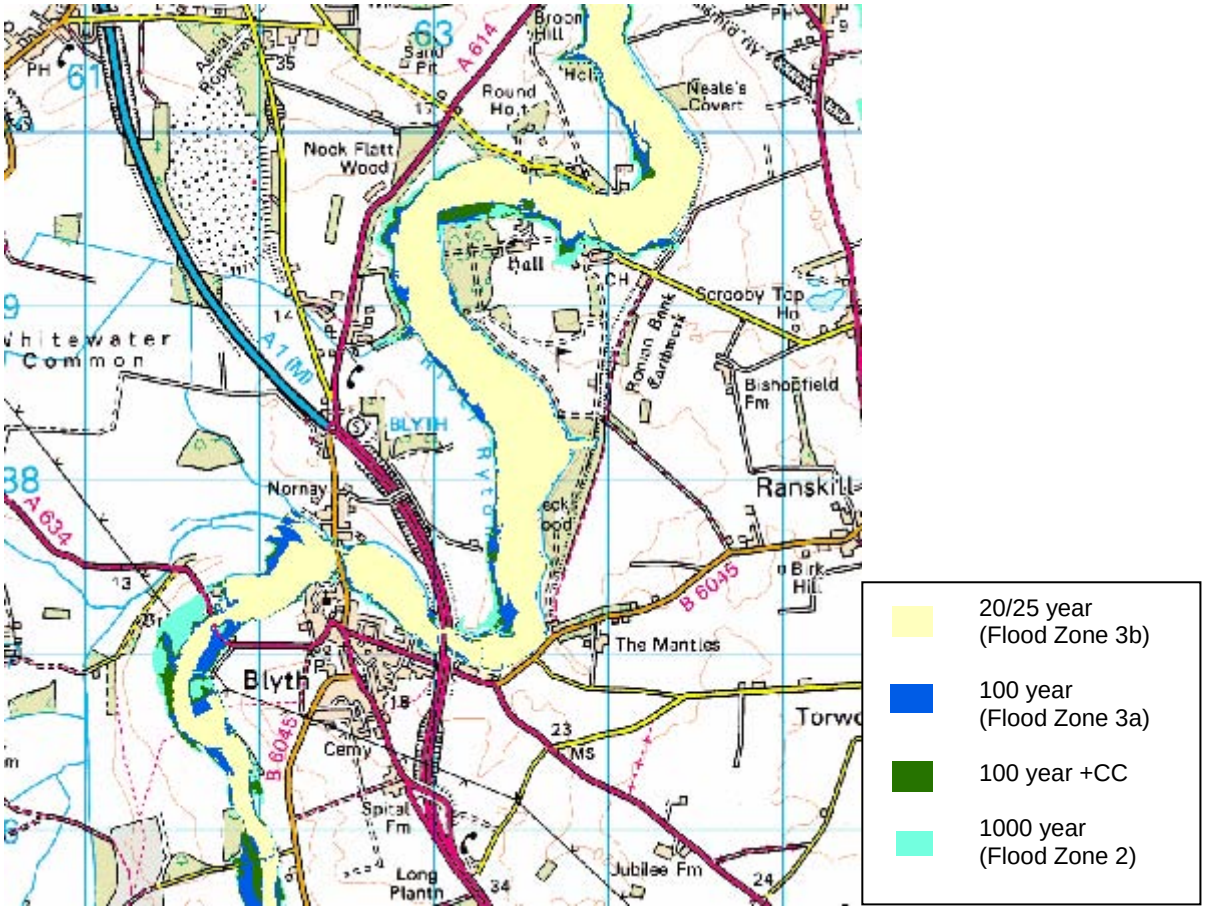
5.4.1 Defended Flood Outlines in Bassetlaw

The following shows an extract from the Defended Flood Outline map for use in Bassetlaw villages close to the Rivers Idle, Ryton and Trent. The full map can be found in Volume 4.

For the Rivers Idle and Ryton, defended flood outlines are shown for the 20/25 year flood (Flood Zone 3b) the 100 year flood (Flood Zone 3a), the 100 year flood with climate change and the 1000 year flood (Flood Zone 2). For the River Trent, defences exist to keep the 100 year flow in bank therefore defended flood outlines have been produced for the 100 year with climate change and 1000 year flood events, demonstrating overtopping of these defences. Washland areas associated with the River Idle and the River Trent are also shown and denoted Functional Floodplain.

For any villages remote from the modelled defended outlines, the Environment Agency broad scale Flood Zone Maps should be consulted as the starting point for application of the Sequential and Exception Tests

Figure 5-16: Bassetlaw Defended Flood Outline Map



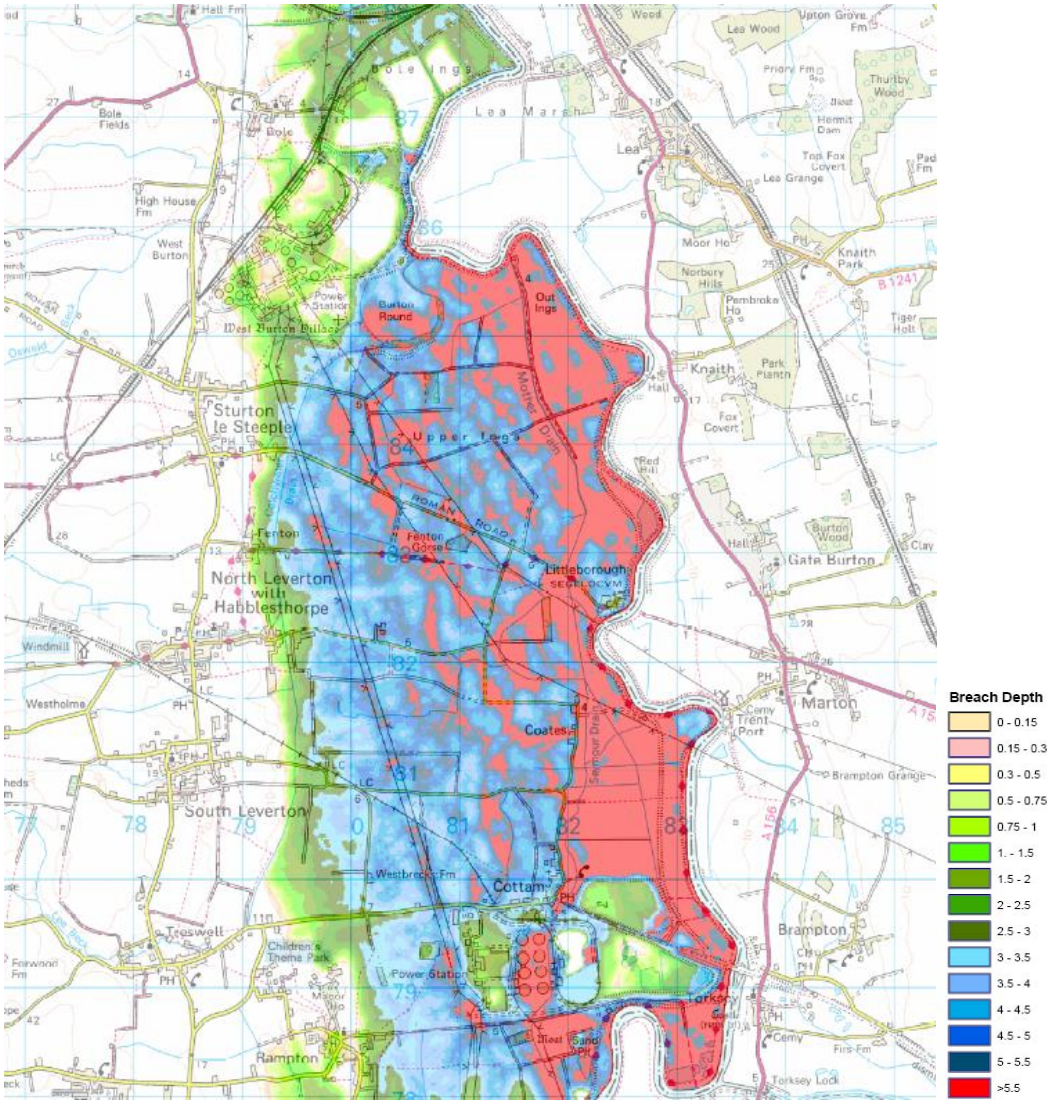
Key Points:

- Defended flood outlines for Rivers Idle, Ryton and Trent only
- To be used as a starting point for Sequential and Exception Tests for villages close to these rivers. For other villages the Environment Agency Flood Map should be used.
- Flood risk from smaller un-mapped watercourses should also be considered
- Non-fluvial flood risk should also be considered

5.4.2 Effects of Breaching of Trent Defences

The following flood extent and depth maps for the River Trent display the possible effects of breaches of flood defence infrastructure along side the Trent. The breach locations were taken from an existing hydraulic model of the River Trent; the depth outlines were created using 2D hydraulic modelling.

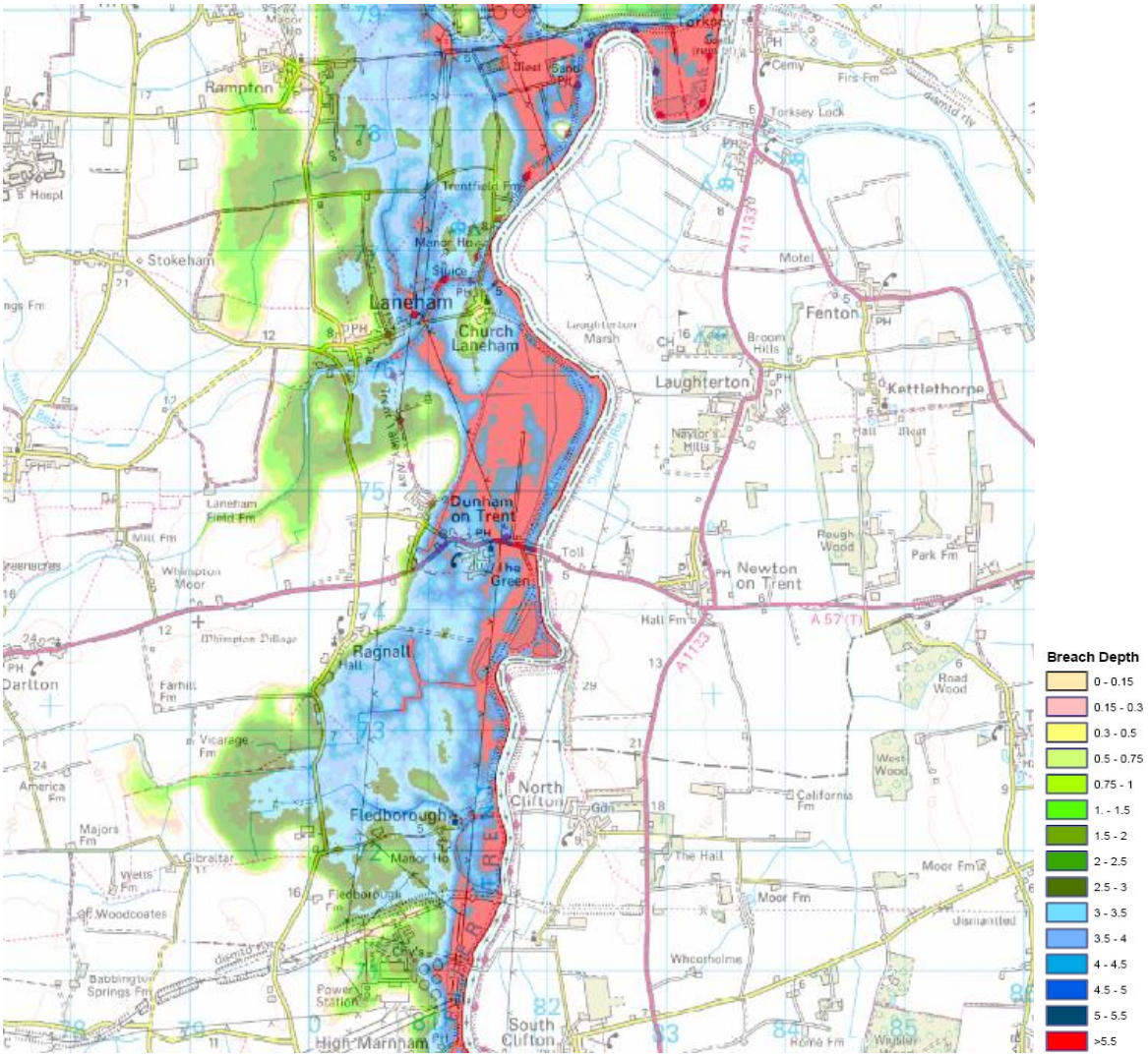
Figure 5-17: Trent Breach Map A



Key Points:

- Flooding at Cottam Power Station
- Flooding in the villages of Rampton, Littleborough, Cottam and Coates
- Roads leading into North Leverton with Habblesthorpe and South Leverton are flooded

Figure 5-18: Trent Breach Map B



Key Points:

- Flooding in the villages of Laneham, Dunham on Trent and Fledborough
- Flooding at High Marnham Power Station
- Flooding of major roads crossing the Trent

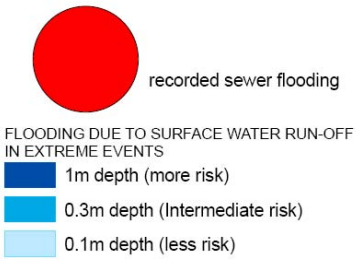
5.4.3 Bassetlaw Villages Non-Fluvial Flood Risk Maps

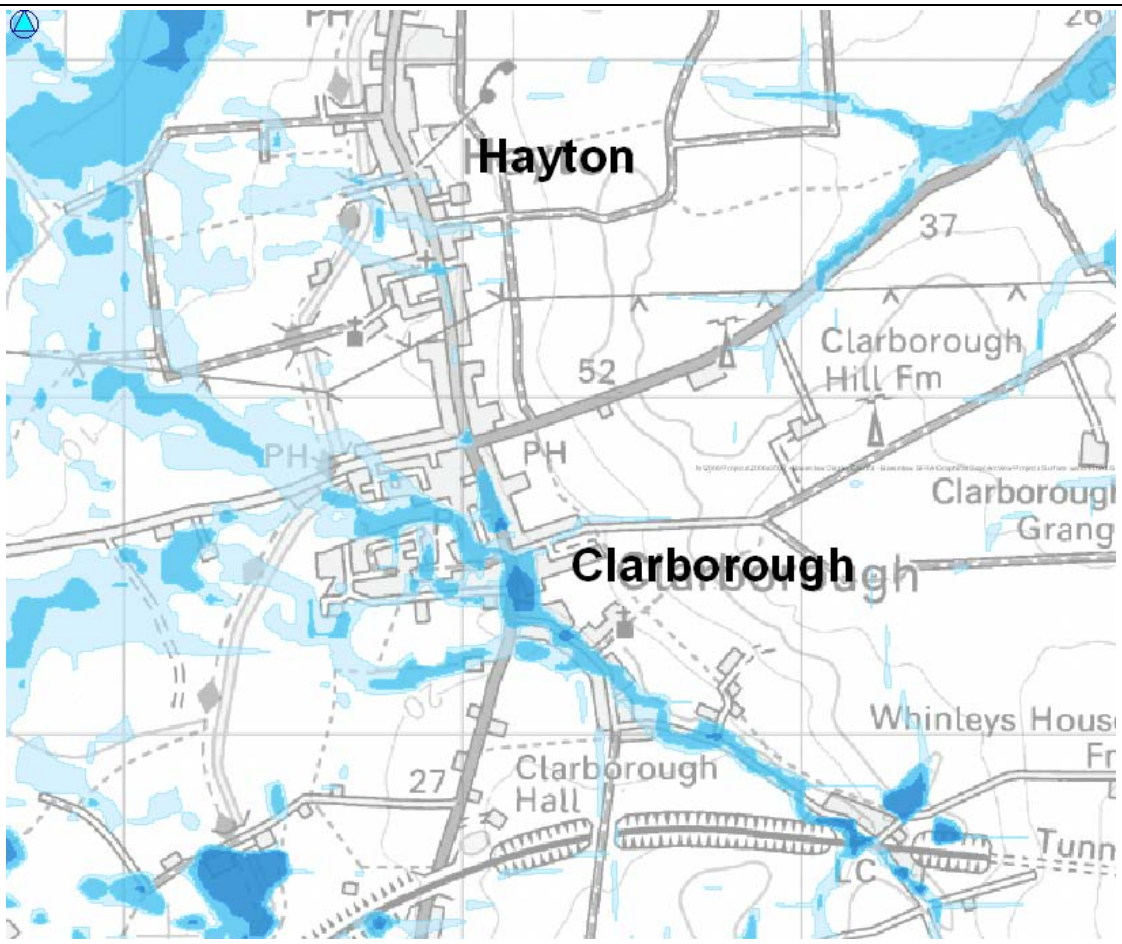
The following non-fluvial flood risk maps show the flood risk in villages within the Bassetlaw District from other sources of flooding, including groundwater, possible overland flow during extreme rainfall and flooding from surcharged or blocked sewers. Many of the villages in Bassetlaw have their own unique problems associated with lack of capacity in the public sewer network or inadequate land drainage. Maps are shown below for the worst affected villages and those which would be susceptible as a result of possible infill development. Key points are also made regarding fluvial flood risk in the selected villages.

Key Points:

- Surface water maps show the effects of a 1 in 200 yr chance rainfall event assuming all sewer systems are full to capacity. Flood outlines highlight areas where water is prone to collect and thus highlights the need for further consideration during development planning.
- Sewer flooding records were provided by Severn Trent
- Areas of past recorded sewer flooding highlight the need for further investigation only – the map is not aimed to preclude all future development at these locations.
- Flood Risk Assessments for development in areas at “more risk” of surface water flooding should pay particular attention to run-off from surrounding areas. The development proposals should be shown not to be at risk of flooding in a 100 yr + climate change rainfall event.
- Flood Risk Assessments and Drainage Impact Assessments should make reference to the recorded sewer flooding incidents. The proposals should be shown not to be at risk of flooding from sewers. Development proposals should be shown not to exacerbate any existing sewer capacity problems.

Figure 5-19: Hayton and Clarborough Non-Fluvial Flood Map

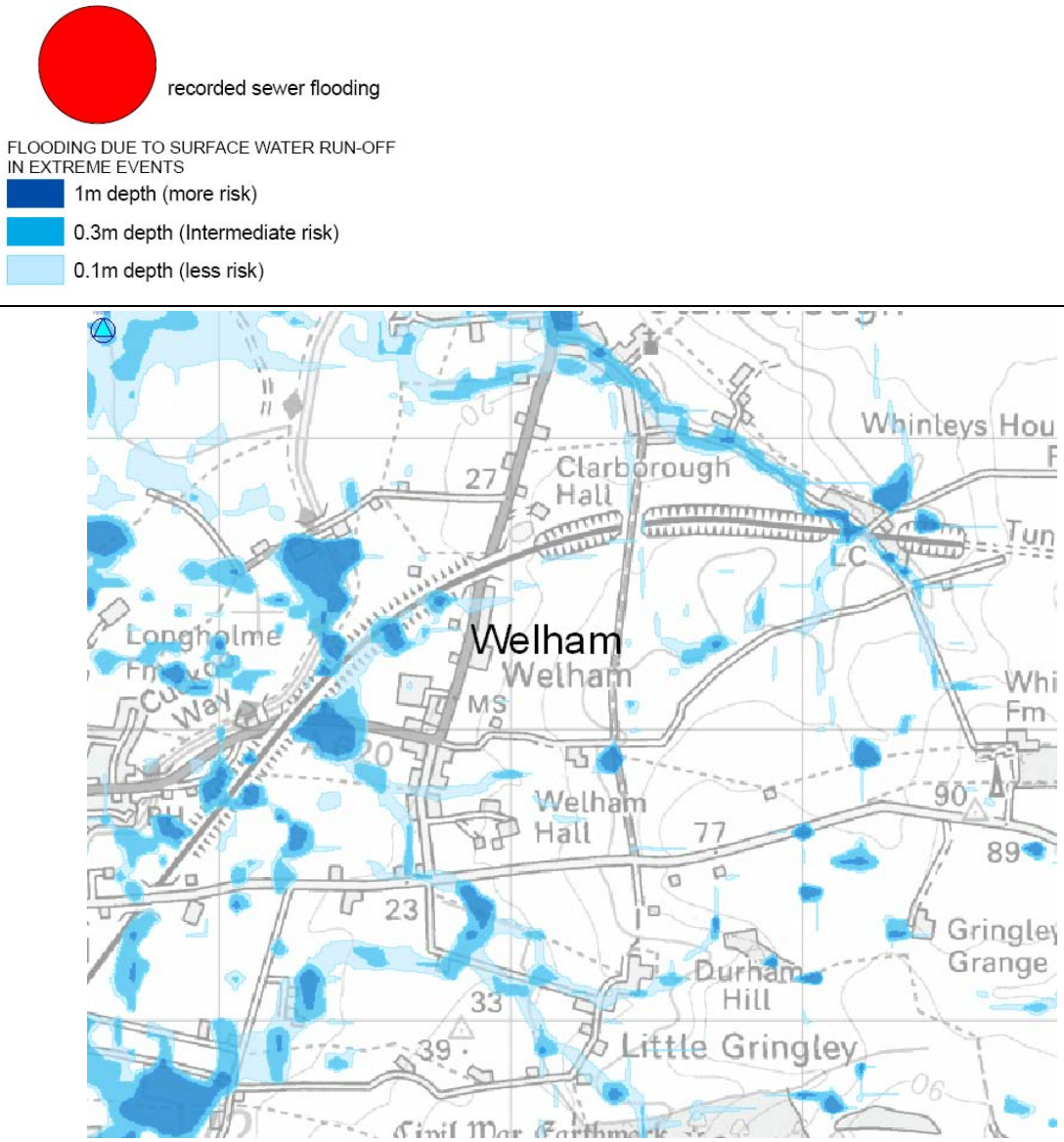




Key Points from Figure 5-19:

- Land drainage capacity problems in Hayton and Clarborough are exacerbated by the amount of infill development that has previously taken place.
- Flood Risk Assessments for development in areas at "more risk" of surface water flooding should pay particular attention to run-off from surrounding areas, due to the typically clayey and relatively impermeable nature of the ground. The development proposals should be shown not to be at risk of flooding in a 100 yr + climate change rainfall event.
- Flood Risk Assessments and Drainage Impact Assessments should make reference to the capacity of the receiving drainage network. The proposals should be shown not to be at risk of flooding from overloaded sewers. Development proposals should be shown not to exacerbate the existing sewer capacity problem.
- The River Idle defended flood outlines for 100 year with climate change and 1000 year events do not encroach on the villages
- Flood risk associated with smaller watercourses and drains in the villages should be considered in Flood Risk Assessments

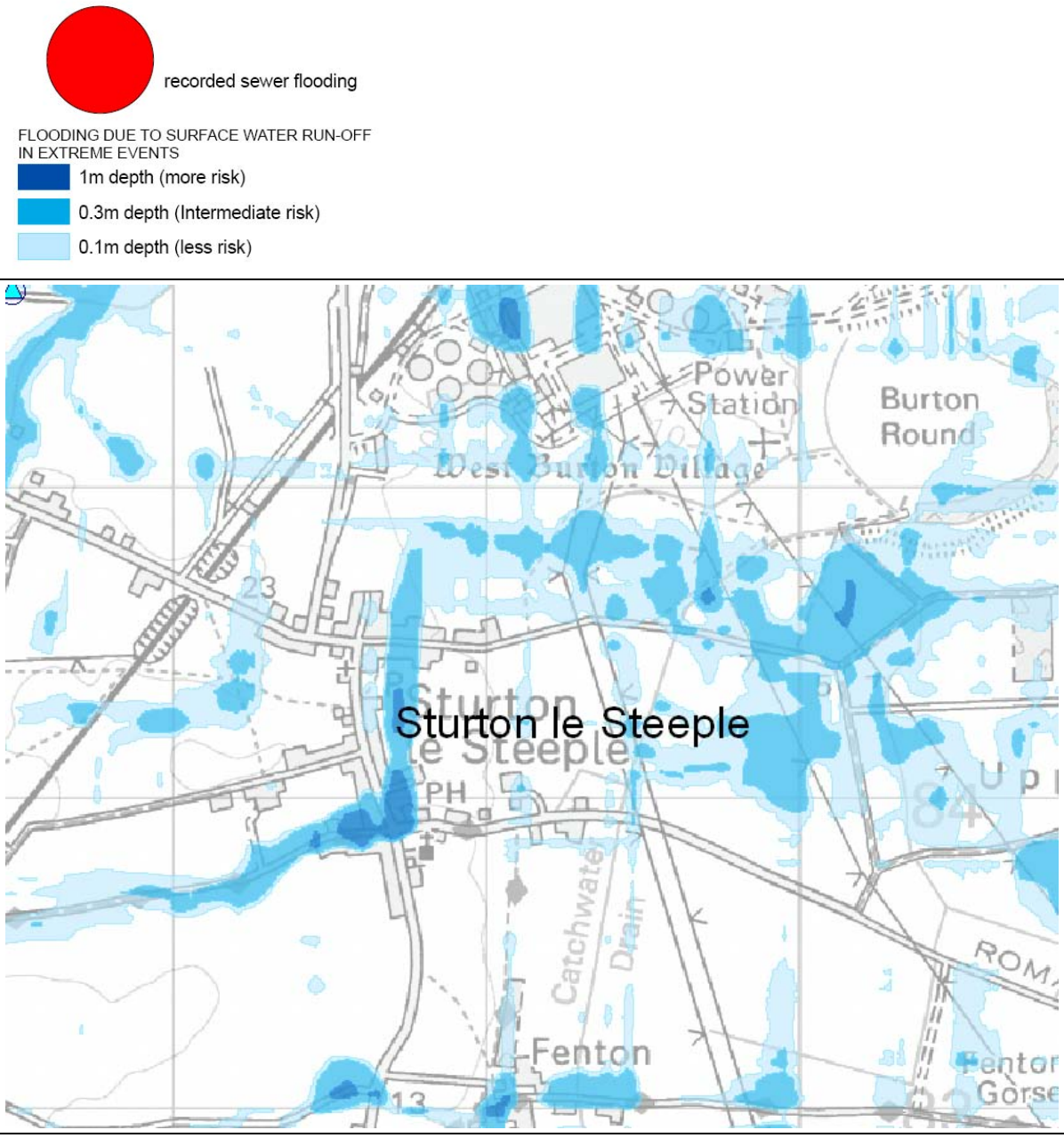
Figure 5-20: Welham Non-Fluvial Flood Map



Key Points:

- Land drainage capacity problems in Welham are exacerbated by the amount of infill development that has previously taken place.
- Flood Risk Assessments for development in areas at "more risk" of surface water flooding should pay particular attention to run-off from surrounding areas. The development proposals should be shown not to be at risk of flooding in a 100 yr + climate change rainfall event.
- Flood Risk Assessments and Drainage Impact Assessments should make reference to the capacity of the receiving drainage network. The proposals should be shown not to be at risk of flooding from overloaded sewers. Development proposals should be shown not to exacerbate the existing sewer capacity problem.
- Flood risk associated with smaller watercourses and drains in the village should be considered in Flood Risk Assessments

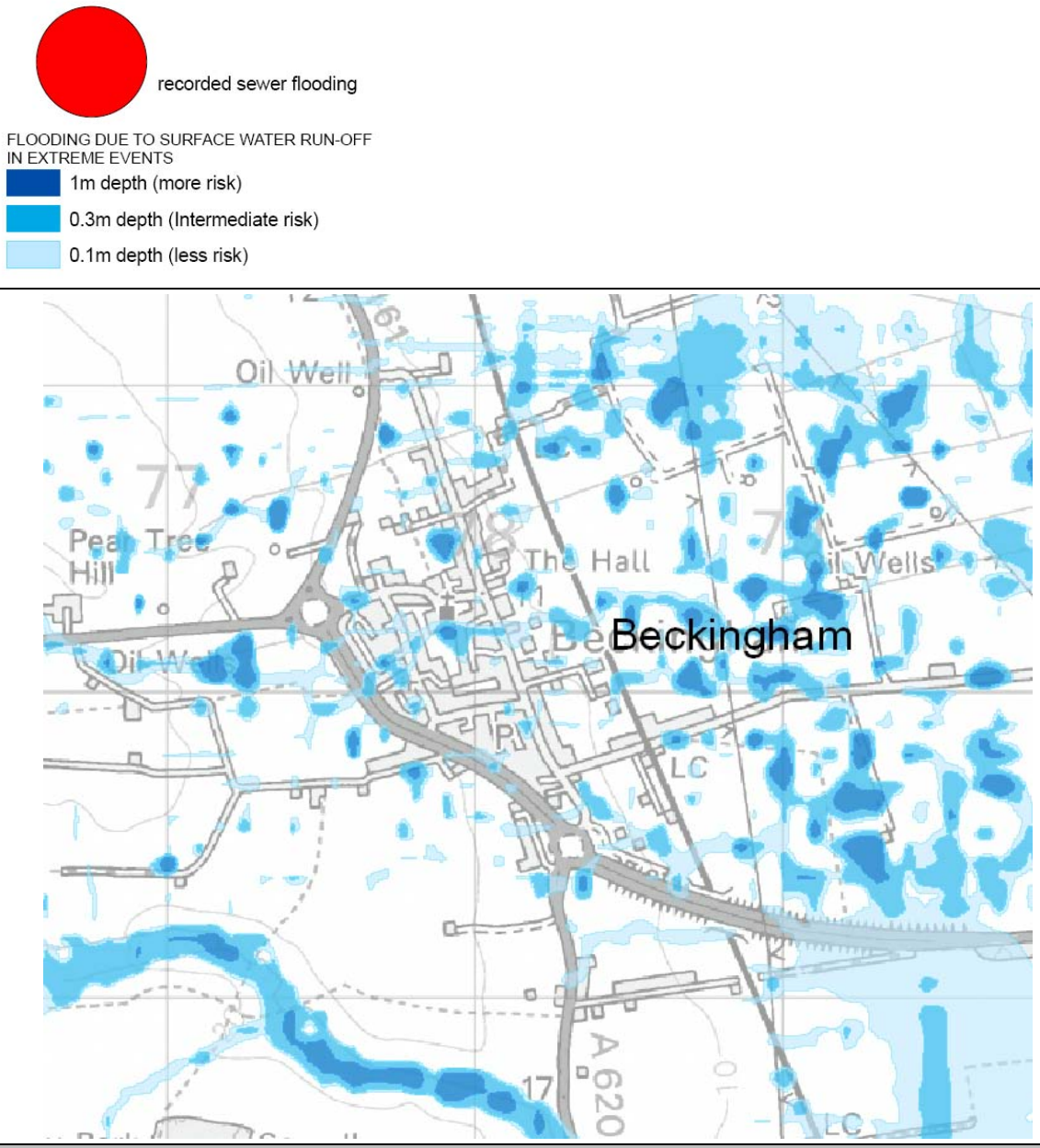
Figure 5-21: Sturton le Steeple Non-Fluvial Flood Map



Key Points from Figure 5-21:

- Sturton le Steeple is located on heavy, clay based soils. Infiltration potential is likely to be low and the area will be more susceptible to flooding by surface water run-off.
- Flood Risk Assessments for development in areas at “more risk” of surface water flooding should pay particular attention to run-off from surrounding areas. The development proposals should be shown not to be at risk of flooding in a 100 yr + climate change rainfall event.
- The River Trent defended flood outlines for 100 year with climate change and 1000 year floods extend to the eastern extremities of Sturton-le-Steeple
- Flood risk associated with smaller watercourses and drains in the village should be considered in Flood Risk Assessments

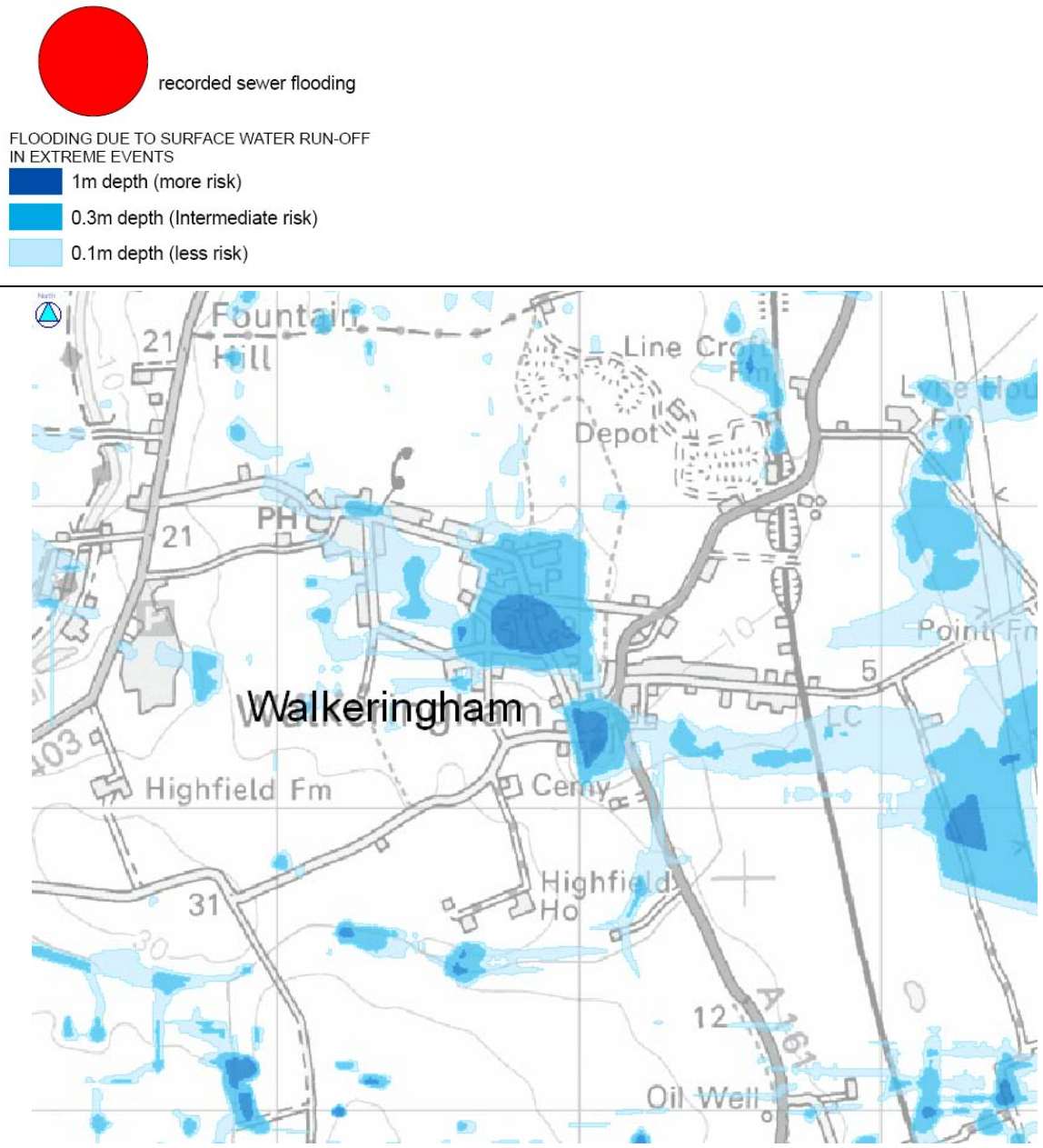
Figure 5-22: Beckingham Non-Fluvial Flood Map



Key Points:

- Beckingham is located on heavy, clay based soils. Infiltration potential is likely to be low and the area will be more susceptible to flooding by surface water run-off.
- Flood Risk Assessments for development in areas at "more risk" of surface water flooding should pay particular attention to run-off from surrounding areas. The development proposals should be shown not to be at risk of flooding in a 100 yr + climate change rainfall event.
- The River Trent defended flood outlines for 100 year with climate change and 1000 year do not encroach into the village

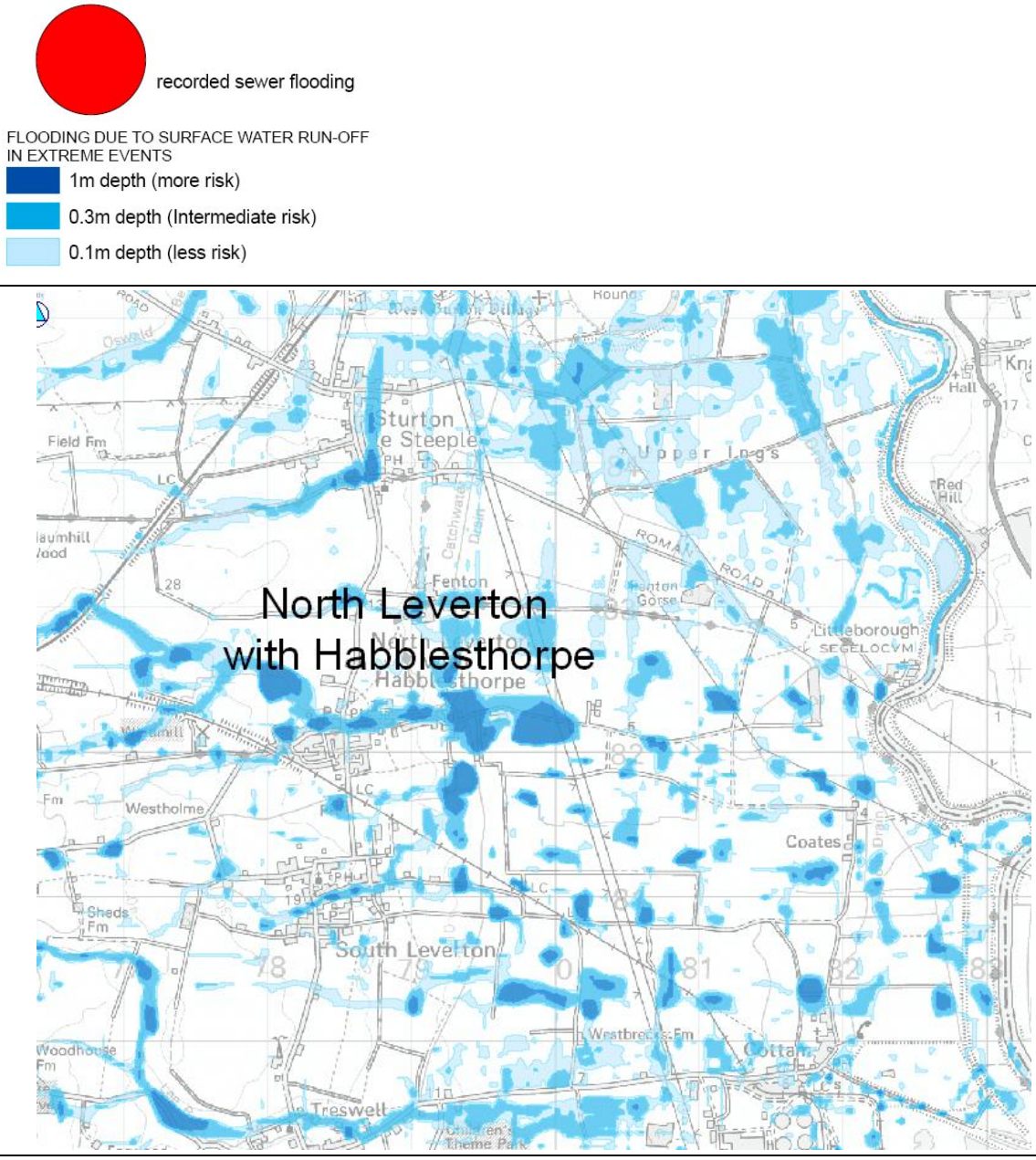
Figure 5-23: Walkeringham Non-Fluvial Flood Map



Key Points from Figure 5-23:

- Land drainage capacity problems in Walkeringham are exacerbated by the amount of infill development that has previously taken place.
- Flood Risk Assessments for development in areas at “more risk” of surface water flooding should pay particular attention to run-off from surrounding areas. The development proposals should be shown not to be at risk of flooding in a 100 yr + climate change rainfall event.
- Flood Risk Assessments and Drainage Impact Assessments should make reference to the capacity of the receiving drainage network. The proposals should be shown not to be at risk of flooding from overloaded sewers. Development proposals should be shown not to exacerbate the existing sewer capacity problem.
- The River Trent defended flood outlines for 100 year with climate change and 1000 year floods are likely to affect the eastern extremities of the village and possibly Beckingham Road to the south of the village
- Flood risk associated with smaller watercourses and drains in the village should be considered in Flood Risk Assessments

Figure 5-24: North Leverton Non- Fluvial Flood Map



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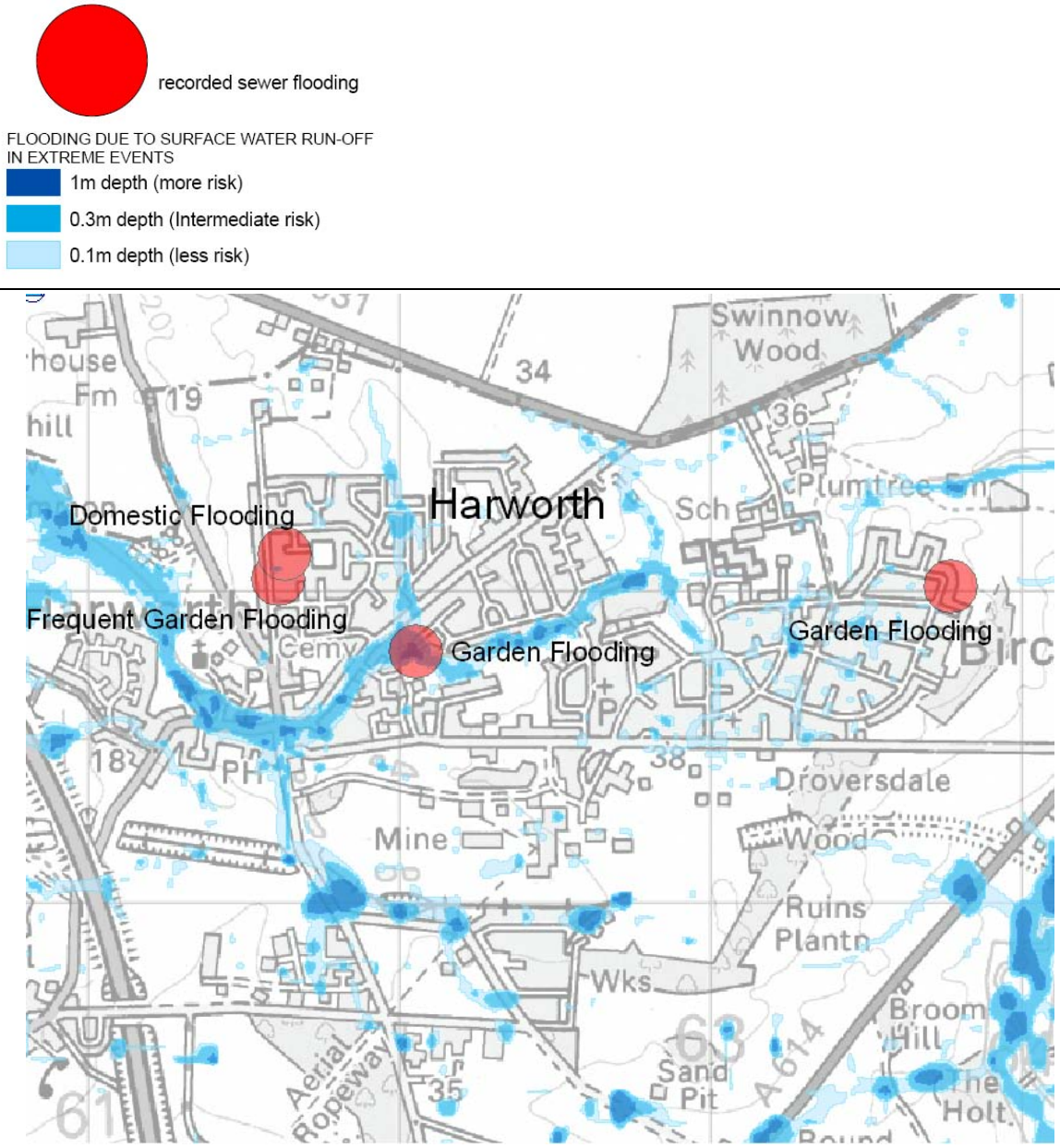
Key Points from Figure 5-24:

- North Leverton is based on typically clayey and impermeable ground, with little potential for infiltration and will be vulnerable to flooding from surface run-off.
- Flood Risk Assessments for development in areas at “more risk” of surface water flooding should pay particular attention to run-off from surrounding areas. The development proposals should be shown not to be at risk of flooding in a 100 yr + climate change rainfall event.
- A watercourse passes directly through the village, increasing the potential impact of development, where surface water discharge may outfall directly to the watercourse.
- The fluvial flood risk associated with this watercourse should be considered in flood risk assessments
- The village is outside the River Trent defended outlines for 100 year with climate change and 1000 year flood events
- Flood risk associated with smaller watercourses and drains in the village should be considered in Flood Risk Assessments

Figure 5-25: Harworth Non-Fluvial Flood Map



Key Points from Figure 5-25:

- Harworth currently has problems with sewer capacity
- Flood Risk Assessments for development in areas at “more risk” of surface water flooding should pay particular attention to run-off from surrounding areas. The development proposals should be shown not to be at risk of flooding in a 100 yr + climate change event.
- Flood Risk Assessments and Drainage Impact Assessments should make reference to recorded sewer flooding and the capacity of the receiving drainage network. The proposals should be shown not to be at risk of flooding from overloaded sewers. Development proposals should be shown not to exacerbate the existing sewer capacity problem.
- Harworth is outside the defended 100 year with climate change and 1000 year flood outlines for the Rivers Idle and Ryton
- Flood risk associated with smaller watercourses and drains and natural springs in the areas upstream of Harworth and Bircotes should be considered in Flood Risk Assessments

5.5 Flood risk at Mattersey and Misson

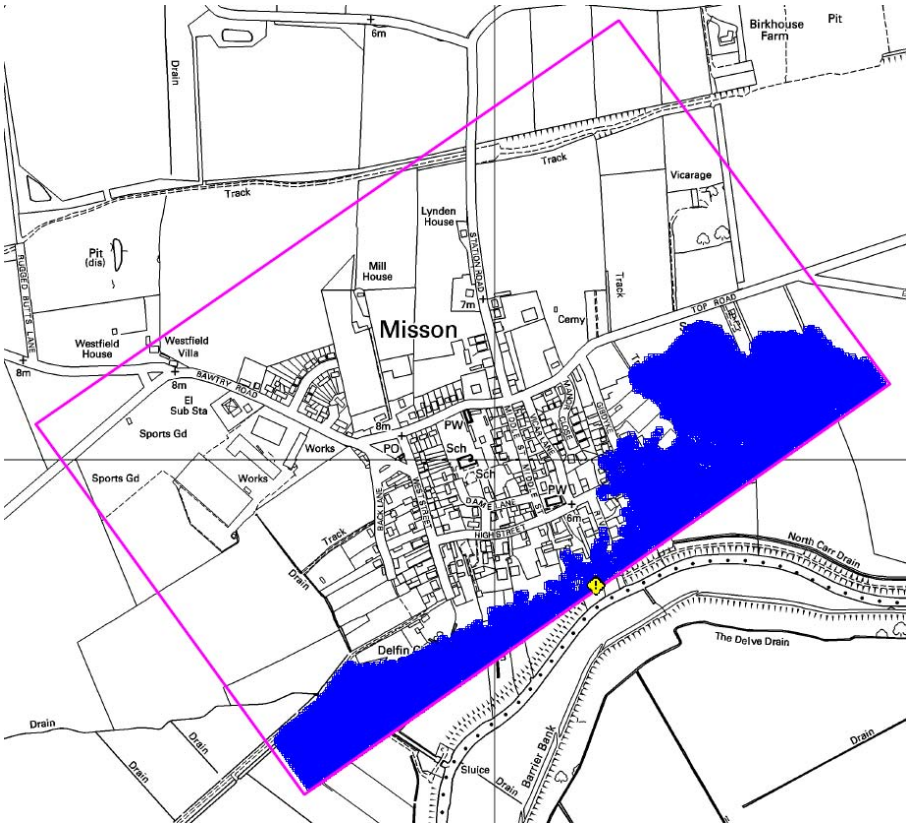
The River Idle is embanked for much of its length downstream of Retford, and one possible flooding mechanism is a breach of the raised earth defences. Two breach locations have been considered and have been modelled for a 100 year flood event; one at Misson and one at Mattersey, to demonstrate the possible consequences.

5.5.1 Misson

The River Idle passes close to Misson. The village lies outside the following defended flood outlines: 25 year (Flood Zone 3b), 100 year (Flood Zone 3), 100 year with climate change and 1000 year (Flood Zone 2). However, the designated Washlands encroach into the Village. The Washlands are areas which are considered important for flood storage and are classed as functional floodplain. The Defended Outlines Map includes the washlands and is contained in Volume 4.

A breach was modelled in the small earth embankment situated on the left bank of the watercourse to the south of the village of Misson, close to River Lane. Model results indicate that if a breach were to occur in this embankment during a 100 year flood event, flood water would inundate River Lane from the south and Gibdyke from the south-east, causing a flood risk to a number of properties in the south-east of the village. Flood water is also shown to move along the floodplain in a downstream direction, inundating open land to the east of the village.

Figure 5-26: Flood defence breach at Misson



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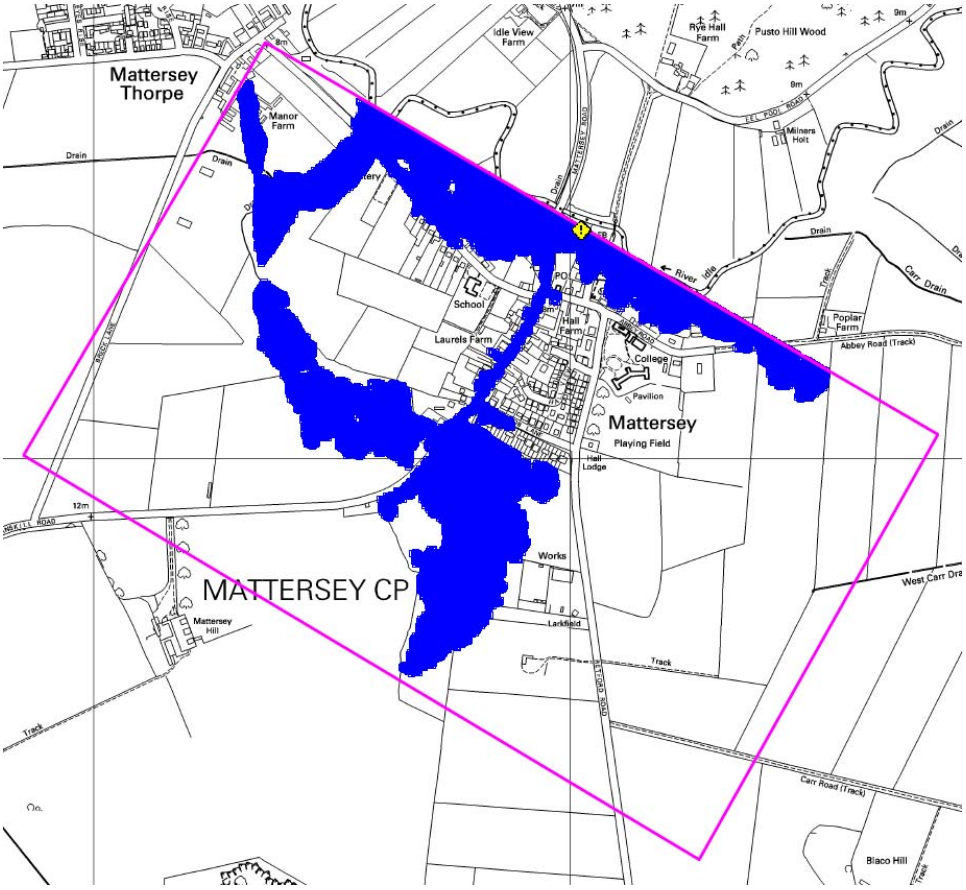
5.5.2 Mattersey

The River Idle passes close to the village of Mattersey. The village lies outside the following defended outlines: 25 year (Flood Zone 3b), 100 year (Flood Zone 3a), 100 year with climate change and 1000 year (Flood Zone 2).

A breach was modelled in the left bank earth flood embankment between Mattersey Road Bridge and the footbridge upstream of the road bridge. Model results indicate that a significant number of properties, which stand adjacent to the watercourse to Abbey Road and Thorpe Road, would be at risk of flooding if a flood defence breach were to occur during a 100 year annual probability flood event. The volume of flood water passing through the breach is shown to be significant for floodwater to flow southwards from the watercourse along Ranskill Road, causing a flood risk to a number of properties along the road, before ponding over a large area of open land to the south of the village. Flood water is also shown to inundate the western end of Job Lane causing a flood risk to a number of properties along the lane.

Figure 5-27: Flood defence breach at Mattersey



6 SUMMARY OF FLOOD RISK IN BASSETLAW

A thorough review of existing information and new more detailed flood modelling work has identified the level of flood risk in the Bassetlaw District. This is summarised below:

Table 6-1: Summary of Flood Risk within Bassetlaw

Source of Flooding	Potential			Comments
	High	Med	Low	
Fluvial Flooding (Rivers)	X			Fluvial flood risk is high within Bassetlaw. The urban areas of Retford and Worksop have minimal flood defence protection and fluvial channels have a limited capacity. The majority of flooding affects open ground, although in more extreme flood events, existing buildings are affected.
Pluvial Flooding (Drainage)		X		It is expected that during moderate rainfall events the drainage system capacity is likely to be exceeded in some areas and further development in these areas will exacerbate this problem
Surface Water Run-off		X		The overall risk to the district remains moderate due to the topography. Sturton Le Steeple and Beckingham and other villages located on heavy clay soils are more likely to be prone to surface run-off problems
Groundwater			X	The risk of groundwater flooding is low. The risk is greater in areas adjacent to watercourses and localised areas close to abandoned mines where groundwater pumping has ceased. This is not thought to be a problem at present but future rebound should be monitored at proposed development sites.

Key points by area:

Worksop:

- The River Ryton has few formal defences
- Culverts in the town are undersized and fail to convey a 1 in 100 annual chance flood event
- Two key areas are vulnerable to flooding – the area around Central Ave, King St, Allen St and Hardy St and the area around Priorswell Rd and Shelley St.

Retford:

- The River Idle has few formal defences through Retford
- Few features along the River Idle through Retford prevent 1 in 100 annual chance flows from overtopping flood banks
- The Chancery Lane area is vulnerable to flooding
- The Retford Beck is prone to frequent flooding at the entrance to culverts, affecting a large area to the East of Retford.

Villages

- Several villages within Bassetlaw suffer from drainage capacity problems and poor sewer networks
- Villages along side the River Trent are at risk from flooding if flood defences fail
- Key villages identified with drainage or flooding problems are
    - Clarborough, Hayton, Welham and Walkeringham where the drainage capacity problems are exacerbated by the amount of infilling development and lack of supporting infrastructure;
    - Sturton le Steeple and Beckingham which are located in areas of clay based soils and poor sewer networks;
    - North Leverton where a watercourse passes through the village and the potential impact of development with direct sewer outfalls to the watercourse would have significant consequences;
    - Harworth, which has public sewer capacity problems and an inadequate land drainage system. There are also natural springs in the upstream areas of Harworth and Bircotes which exacerbate surface water problems.

[1] Planning Policy Statement 25: Development and Flood Risk – December 2006

[2] DEFRA/Environment Agency. 2005. *Flood Risk Assessment Guidance for New Development.* R&D Technical Report FD2320/TR2.
http://sciencesearch.defra.gov.uk/Document.aspx?Document=FD2320_3364_TRP.pdf

[3] DEFRA/Environment Agency. 2008. Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose.
http://sciencesearch.defra.gov.uk/Document.aspx?Document=FD2320_7399_PR.pdf

[4] Communities and Local Government. 2008. *Planning Policy Statement 25: Development and Flood Risk* – Practice Guide. June 2008.
http://www.communities.gov.uk/publications/planningandbuilding/pps25practiceguide

[5] Definition of minor development:
- Minor non-residential extensions: Industrial/Commercial/Leisure etc. extensions with a footprint less than 250m^2
- Alterations: development that does not increase the size of buildings e.g. alterations to external appearance.
- 'Householder' development: e.g. sheds, garages, games rooms etc. within the curtilage of the existing dwelling in addition to physical extensions to the existing dwelling itself. This definition **excludes** any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.

[6] Communities and Local Government. 2006. *Planning Policy Statement 25: Development and Flood Risk*. December 2006.
http://www.communities.gov.uk/publications/planningandbuilding/pps25floodrisk

[7] DEFRA. 2004. *Making Space for Water; Developing a new Government strategy for flood and coastal erosion risk management in England, A consultation exercise.*
http://www.defra.gov.uk/environ/fcd/policy/strategy.htm

[8] Communities and Local Government. 2006 *Planning Policy Statement 25: Development and Flood Risk.* Annex G paragraph G2.