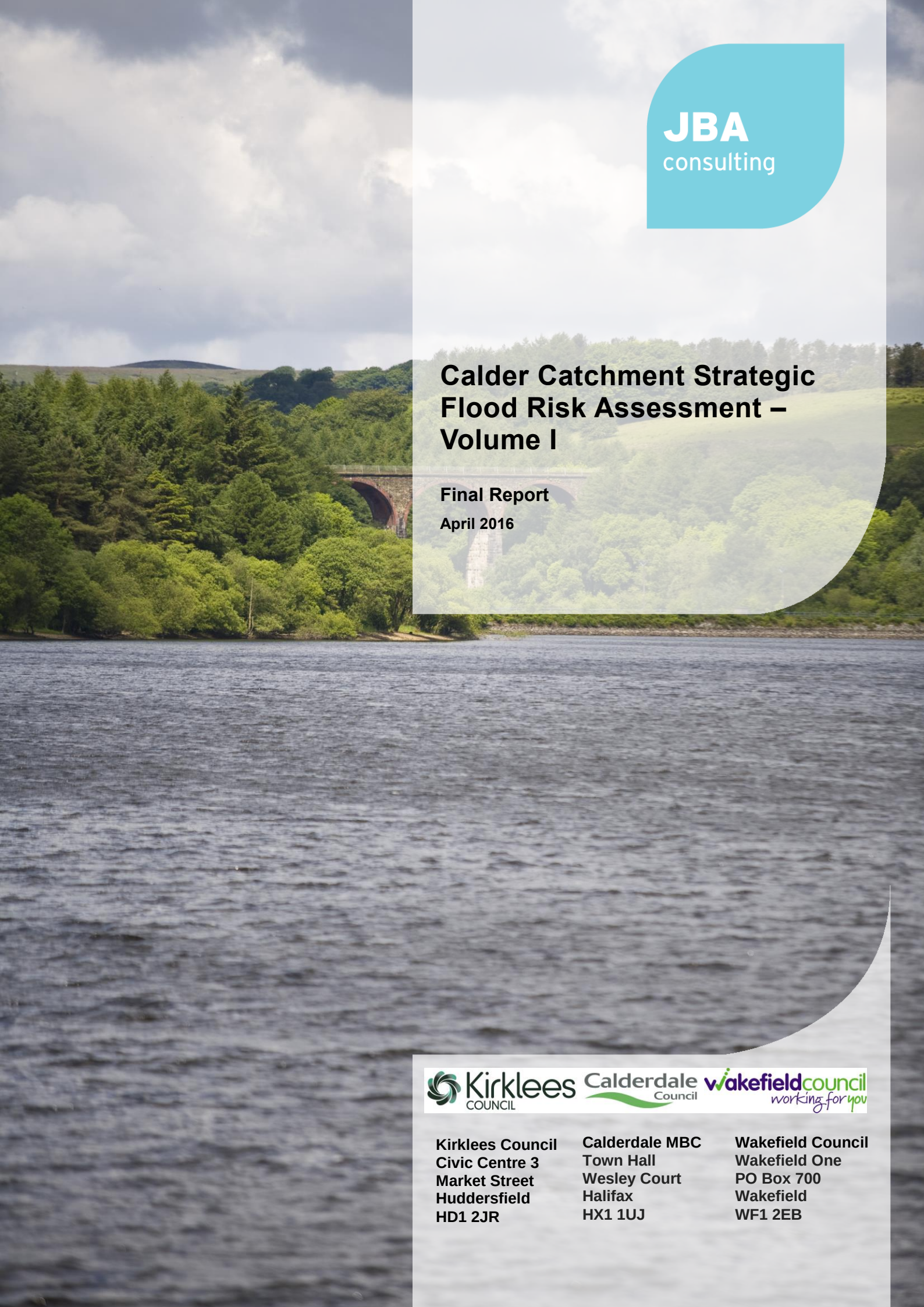

Calder Catchment Strategic Flood Risk Assessment – Volume I

Final Report

April 2016

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Draft (Level 1 SFRA) Report Version 1.1	Comments on Version 1.0	
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Final (Level 1 SFRA) Report Version 1.2 / April 2016	Final Comments addressed	Tom Ghee, Steven Wright, Paul Farndale (KC) Jason Morris, John Houston (CMBC) Paul Maddison, Neville Ford (WC)

Contract

This report describes work commissioned by Tom Ghee, on behalf of Kirklees Council, Calderdale Metropolitan Borough Council and Wakefield Council, by email dated 13 September 2013. The Council's lead representative for the contract was Tom Ghee of Kirklees MBC. Mike Williamson of JBA Consulting carried out this work.

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Purpose

This document has been prepared as a final report for Kirklees Council, Calderdale Metropolitan Borough Council and Wakefield Council. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to the aforementioned Councils.

Acknowledgements

JBA would like to thank all Council, Environment Agency and Canal & River Trust staff for their time and commitment to providing data and discussing the issues identified during the course of this study.

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Abbreviations

AIMS ..... Asset Information Management System
AStSWF ..... Areas Susceptible to Surface Water Flooding
AStGWF..... Areas Susceptible to Ground Water Flooding
CDA ..... Critical Drainage Area
CFMP..... Catchment Flood Management Plan
CMBC ..... Calderdale Metropolitan Borough Council
DCLG ..... Department of Communities and Local Government
FMfSW ..... Flood Map for Surface Water
FRA..... Flood Risk Assessment
FWMA..... Flood and Water Management Act
KC ..... Kirklees Council
LFRMS..... Local Flood Risk Management Strategy
LLFA ..... Lead Local Flood Authority
LPA ..... Local Planning Authority
NFCDD ..... National Flood and Coastal Defence Database
NPPF ..... National Planning Policy Framework
PFRA ..... Preliminary Flood Risk Assessment
PPM ..... Planned Preventative Maintenance
PPS..... Planning Policy Statement
RBMP..... River Basin Management Plan
RFRA ..... Regional Flood Risk Appraisal
RMA..... Risk Management Authority
SA ..... Sustainability Appraisal
SAB..... SUDS Approval Board
SFRA ..... Strategic Flood Risk Assessment
SIRS..... Sewerage Incident Register System
SWMP..... Surface Water Management Plan
uFMfSW ..... updated Flood Map for Surface Water
WC..... Wakefield Council
WFD..... Water Framework Directive
WIRS..... Wastewater Incident Register System

1 Introduction

1.1 Commission

Kirklees Council (KC) commissioned JBA Consulting in September 2013 to undertake an update of the existing Level 1 Strategic Flood Risk Assessment (SFRA) in accordance with the Government's development planning guidance. The commission is in partnership with Calderdale Metropolitan Borough Council (CMBC) and Wakefield Council (WC). This updated SFRA makes use of the most up-to-date flood risk datasets to assess risk to the proposed development allocation sites and key settlements in the three Council areas.

1.2 Calder Catchment SFRA

As Lead Local Flood Authorities (LLFA) and Local Planning Authorities (LPA), each Council requires an SFRA to develop the evidence base for their Local Plans and to inform the Sustainability Appraisal (SA). The aims and objectives of the SFRA are:

- To form part of the evidence base and inform the Sustainability Appraisal (Incorporating the Strategic Environmental Assessment) for the council's Local Plans.
- To assist in the preparation of and to make recommendations of appropriate policies for the management of flood risk within the Council's Local Plans.
- To understand flood risk from all sources and to investigate and identify the extent and severity of flood risk throughout the Calder Valley catchment in each Council area. This assessment will enable the Councils to steer development away from those areas where flood risk is considered greatest, ensuring that areas allocated for development can be developed in a safe, cost effective and sustainable manner.
- To pay particular attention to surface water flood risk, using the Environment Agency's third generation updated Flood Map for Surface Water (uFMfSW), and to explore the proposed designation of Critical Drainage Areas (CDAs).
- To enable the Councils to meet their obligations under the National Planning Policy Framework (NPPF) and technical guidance.
- To assess the suitability of potential development site allocations across the Calder catchment.
- To supplement current policy guidelines and to provide a straightforward risk based approach to development management in the area. This is aimed at Councillors, the public and developers.
- To provide a reference document to which all parties involved in development planning and flood risk can reliably turn to for initial advice and guidance.
- To develop a report that forms the basis of an informed development management process that also provides guidance on the potential risk of flooding associated with future planning applications and the basis for site specific Flood Risk Assessments (FRAs) where necessary.
- To identify land required for current and future flood management that should be safeguarded as set out in the NPPF.
- To assist the Councils in identifying specific locations where further and more detailed flood risk data and assessment work is required as part of a Level 2 SFRA, prior to the allocation of specific developments.

1.2.1 Report Format

The Level 1 SFRA has been produced in two volumes, one generic 'front end' document applicable to all three Councils making up Volume I, and three separate documents aimed at each Council making up Volume II. Volume I (this report) introduces the SFRA and provides background information on flood risk. The Volume II reports cover the Planning Framework and flood risk policy whilst assessing actual flood risk, flood risk relative to proposed development sites and conclusions and recommendations for further work.

Each volume has been prepared in sections, supported by mapping, which will enable users to identify and focus on their particular requirements and areas of interest. The strategic assessment of risk has broadly been carried out through the collection of readily available flood risk information in order to provide a spatial assessment of flood risk from all sources across the catchment and through a review of strategic development options identified by the Councils to allow the application of the Sequential Test, where applicable.

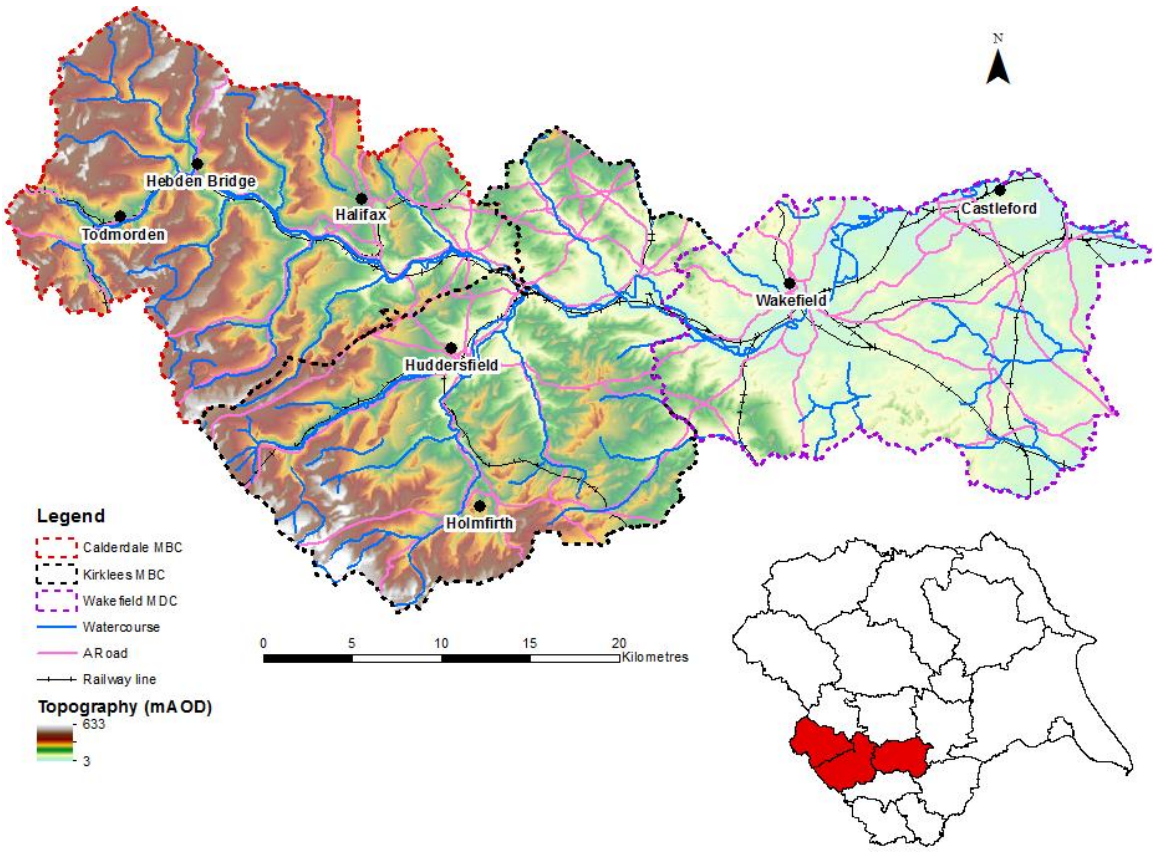
Kirklees Council and Wakefield Council decided not to carry out a review of their allocated development sites but rather a review of key settlements and the overall catchment.

1.2.2 Study Area

The SFRA area covers the majority of the River Calder catchment, taking in the Metropolitan Boroughs of Kirklees and Calderdale and the Metropolitan District of Wakefield within the County of West Yorkshire, England. Kirklees covers an area of approximately 409 km², Calderdale an area of approximately 364 km² and Wakefield an area of around 339 km². The three Council areas are bounded by the other West Yorkshire districts of Bradford and Leeds; Selby in North Yorkshire; Doncaster and Barnsley in South Yorkshire; the Derbyshire district of the High Peak; and the Lancashire districts of Oldham, Rochdale, Rossendale, Burnley and Pendle.

The main urban areas that service each Council area are Huddersfield in Kirklees, Halifax in Calderdale and Wakefield in the Wakefield district. The populations (Census, 2011[1]) of each Council area are approximated at 423,000 in Kirklees, 204,000 in Calderdale and 326,000 in the district of Wakefield.

Figure 1-1: Calder Catchment SFRA Study Area

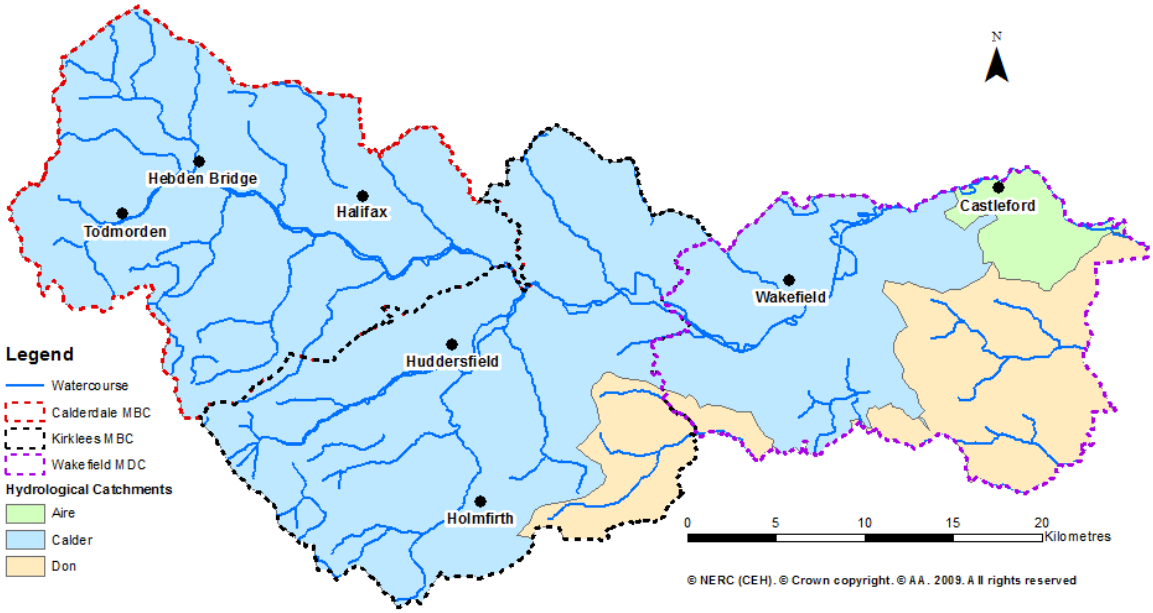


The SFRA area also covers areas of the Rivers Don and Aire catchments. Each catchment has its own unique characteristics and flooding issues that need to be considered as part of the planning process. It will be helpful to planners and developers to have an overview of these factors prior to undertaking the Sequential and Exception Tests as part of the risk based sequential approach and then allocating proposed development sites in these catchments. The principle catchment characteristics and flooding issues from different sources are discussed in

1 http://www.ons.gov.uk/ons/guide-method/census/2011/index.html

the next few sections. Figure 1-2 shows the three separate hydrological catchments[2] within the SFRA study area.

Figure 1-2: Hydrological Catchments



Calder Catchment

The River Calder rises on the Pennine Moors west of Todmorden. It is predominantly an urban river, flowing through the West Yorkshire towns of Hebden Bridge, Brighouse, Dewsbury and Wakefield, before it joins the River Aire at Castleford. The upper reaches of the Calder and many of its tributaries flow through steep and relatively narrow valleys, which means they react quickly to rainfall. Heavy rainfall causes rapid rises in water level, which contributes to the flood risk in many of the communities. Downstream of Dewsbury the floodplains of the Calder broaden and include large areas of washland. These washlands act as flood storage areas attenuating peak flows. Consequently water levels rise and fall more slowly and peak flows are often lower than upstream of Dewsbury.

Aire Catchment

The River Aire flows in a general south easterly direction from its source in the Yorkshire Dales near Malham to its confluence with the River Ouse near Goole. The catchment has an area of approximately 2,060 km2 (including the River Calder).

The catchment is predominantly rural in nature. The River Aire has been considerably modified for flood defence purposes. Long reaches of the channel are embanked and there are several controlled washland (floodplain) areas. These controlled washlands and also a number of uncontrolled washlands significantly attenuate peak flows along the river.

Castleford and Knottingley (in the Wakefield district) are situated on the right (southern) banks of the River Aire. Large areas of the River Aire floodplain through this reach are designated as washland and flood flows are attenuated substantially by these washland systems. The washlands are predominantly located on the left (north) bank of the River Aire.

The River Aire catchment also contains Wash Dike and Oulton Beck which drain parts of the Wakefield district (Pontefract, Knottingley and Lofthouse Gate).

Don Catchment

The River Don rises on the Southern Pennines, an area of high ground formed of Millstone Grit and Coal Measures. The river generally flows in a northerly direction toward the River Ouse. The Don's two main tributaries are the River Rother to the South and the Dearne to the North. A

2 CEH 2009. The Flood Estimation Handbook CD-ROM 3. Centre for Ecology & Hydrology, Wallingford, Oxon, UK.

further two main rivers, Ea Beck and the River Went, join the Don downstream of Doncaster. The total area of the Don Catchment is 1,682 km².

Wakefield district includes the upper parts of the River Went and Ea Beck catchments. These catchments are low lying and very flat. Within the Wakefield district the catchments are partly drained under the management of the DANVM Internal Drainage Board.

Kirklees district includes the upper reaches of the River Dearne and catchment. The upper reaches of the Dearne catchment are more elevated and much steeper than the River Went and Ea Beck and consequently these watercourses respond quickly to rainfall. The River Dearne also flows through Wakefield at Bretton, in the Sculpture Park.

2 Understanding Flood Risk

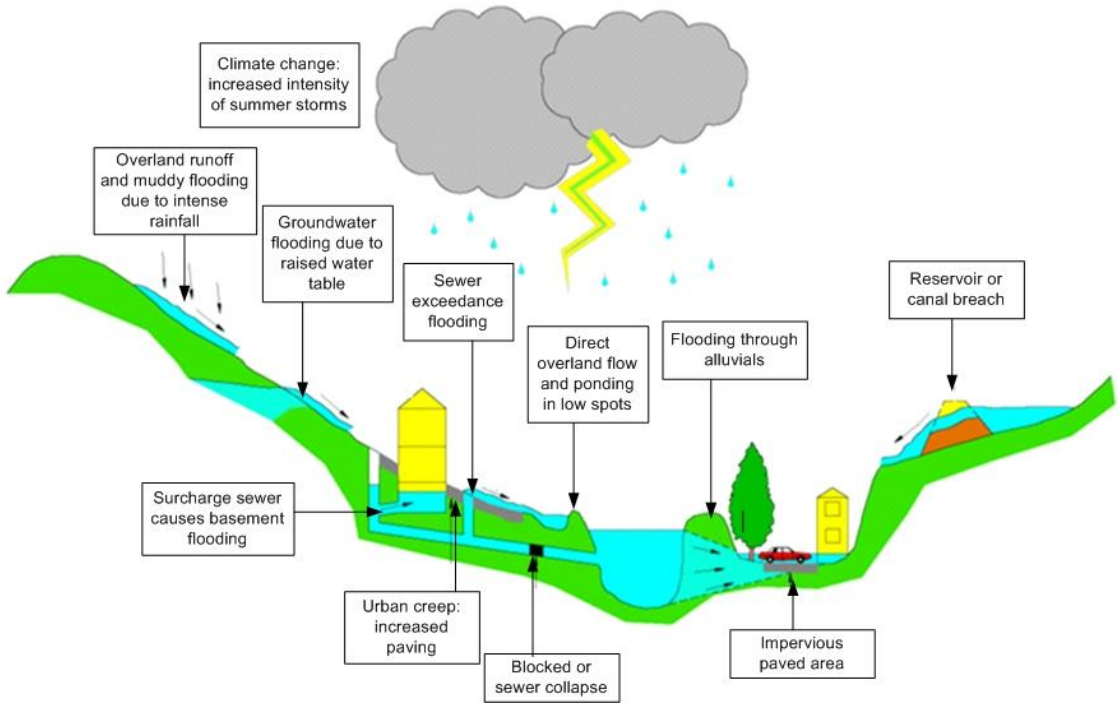
2.1 Sources of Flooding

Flooding is a natural process and can happen at any time in a wide variety of locations. It constitutes a temporary covering of land not normally covered by water and presents a risk when people and human or environmental assets are present in the area that floods. Assets at risk from flooding can include housing, transport and public service infrastructure, commercial and industrial enterprises, agricultural land and environmental and cultural heritage. Flooding can occur from many different and combined sources and in many different ways. Major sources of flooding include (also see Figure 2-1):

- **Fluvial** (rivers) - inundation of floodplains from rivers and watercourses; inundation of areas outside the floodplain due to influence of bridges, embankments and other features that artificially raise water levels; overtopping or breaching of defences; blockages of culverts; blockages of flood channels/corridors.
- **Tidal** - sea; estuary; overtopping of defences; breaching of defences; other flows (e.g. fluvial surface water) that could pond due to tide locking; wave action.
- **Surface water** - surface water flooding covers two main sources including sheet run-off from adjacent land (pluvial) and surcharging of piped drainage systems (public sewers, highway drains, etc.)
- **Groundwater** - water table rising after prolonged rainfall to emerge above ground level remote from a watercourse; most likely to occur in low-lying areas underlain by permeable rock (aquifers); groundwater recovery after pumping for mining or industry has ceased.
- **Infrastructure failure** - reservoirs; canals; industrial processes; burst water mains; blocked sewers or failed pumping stations.

Different types and forms of flooding present a range of different risks and the flood hazards of speed of inundation, depth and duration of flooding can vary greatly. With climate change, the frequency, pattern and severity of flooding are expected to change and become more damaging.

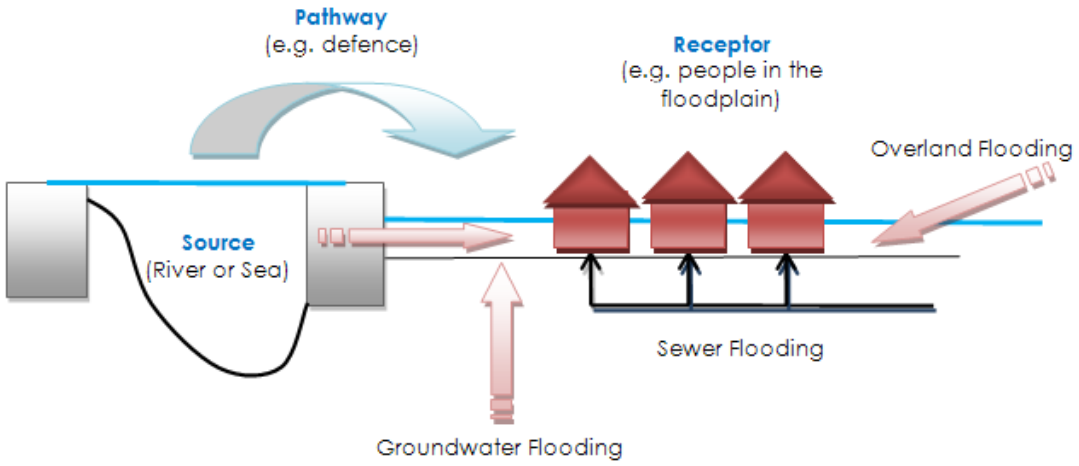
Figure 2-1: Flooding from all Sources



2.2 Likelihood and Consequence

Flood risk is a combination of the likelihood of flooding and the potential consequences arising. It is assessed using the source – pathway – receptor model as shown in Figure 2-2 below. This is a standard environmental risk model common to many hazards and should be the starting point of any flood-risk assessment. However, it should be remembered that flooding could occur from many different sources and pathways, and not simply those shown in the illustration below.

Figure 2-2: Source-Pathway-Receptor Model



The principal sources are rainfall or higher than normal sea levels, the most common pathways are rivers, drains, sewers, overland flow and river and coastal floodplains and their defence assets and the receptors can include people, their property and the environment. All three elements must be present for flood risk to arise. Mitigation measures have little or no effect on sources of flooding but they can block or impede pathways or remove receptors.

The planning process is primarily concerned with the location of receptors, taking appropriate account of potential sources and pathways that might put those receptors at risk. It is therefore important to define the components of flood risk in order to apply this guidance in a consistent manner.

2.2.1 Likelihood

Likelihood of flooding is expressed as the percentage probability based on the average frequency measured or extrapolated from records over a large number of years. A 1% probability indicates the flood level that is expected to be reached on average once in a hundred years, i.e. it has a 1% chance of occurring in any one year, not that it will occur once every hundred years. Table 2-1 provides an example of the flood probabilities used to describe Flood Zones as defined in the NPPF Technical Guide.

Table 2-1: NPPF Flood Zones

Flood Zone	Annual probability of flooding
1	This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%).
2	This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.
3a	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.
3b	This zone comprises land where water has to flow or be stored in times of flood. This includes land that would flood with an annual probability of 1 in 20 (5%) or 1 in 25 (4%) or greater in any year, or is designed to flood in an extreme (0.1%) flood.

As part of this SFRA, a further indicative flood zone has been delineated called Flood Zone 3ai. Flood Zone 3ai includes developed land with the same level of risk as Flood Zone 3b where water would flow or be stored in times of flooding if not already constrained by development. In NPPF terms this is part of Flood Zone 3a but following discussions with the local authorities and the Environment Agency it was agreed that Flood Zone 3a should be subdivided. Identification of zone 3ai allows the councils to assess risk within 3a in more detail showing areas where existing development is likely to be restricting flood flows and water storage that would otherwise be within the functional floodplain.

Should sites in Flood Zone 3ai become available for new or further development (e.g. as brownfield sites) then both the risk at the sites and their role in managing flood risk in the surrounding area should be carefully considered with no increase in development footprint. Flood Zone 3ai includes the areas of land that would be in Flood Zone 3b if not already developed and should therefore be used as an indicator of flood risk, from a modelled 1 in 20/25 year event, to existing developed sites'.

Considered over the lifetime of development, such an apparently low frequency or rare flood has a significant probability of occurring. For example:

- A 1% flood has a 26% (1 in 4) chance of occurring at least once in a 30-year period - the period of a typical residential mortgage
- And a 49% (1 in 2) chance of occurring in a 70-year period - a typical human lifetime

2.2.2 Consequence

The consequences of flooding can result in fatalities, damaging property, disrupting lives and businesses, with severe implications for people (e.g. financial loss, emotional distress, health problems). Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure, of the population, presence and reliability of mitigation measures etc). Flood risk is then expressed in terms of the following relationship:

Flood risk = Probability of flooding x Consequences of flooding

2.3 Risk

Flood risk is not static; it cannot be described simply as a fixed water level that will occur if a river overtops its banks or from a high spring tide that coincides with a storm surge. It is therefore important to consider the continuum of risk carefully. Risk varies depending on the severity of the event, the source of the water, the pathways of flooding (such as the condition of flood defences) and the vulnerability of receptors as mentioned above.

2.3.1 Actual Risk

This is the risk 'as is' taking into account any flood defences that are in place for extreme flood events (typically these provide a minimum Standard of Protection (SoP)). Hence, if a settlement lies behind a fluvial flood defence that provides a 1 in 100-year SoP then the actual risk of flooding from the river in a 1 in 100-year event is generally low.

Actual risk describes the primary, or prime, risk from a known and understood source managed to a known SoP. However, it is important to recognise that risk comes from many different sources and that the SoP provided will vary within a river catchment. Hence, the actual risk of flooding from the river may be low to a settlement behind the defence but moderate from surface water, which may pond behind the defence in low spots and is unable to discharge into the river during high water levels.

2.3.2 Residual Risk

Even when flood defences are in place, there is always a likelihood that these could be overtopped in an extreme event or that they could fail or breach. Where there is a consequence to that occurrence, this risk is known as residual risk. Defence failure can lead to rapid inundation of fast flowing and deep floodwaters, with significant consequences to people, property and the local environment behind the defence.

Whilst the actual risk of flooding to a settlement that lies behind a fluvial flood defence that provides a 1 in 100-year SoP may be low, there will always be a residual risk from flooding if these defences overtopped or failed that must be taken into account. Because of this, it is never appropriate to use the term "flood free".

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