Pendle District Level 1 Strategic Flood Risk Assessment

Final Report

July 2021

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Revision history

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Draft V1.0 / January 2021	JBA review	John Halton
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Contract

This report describes work commissioned by Neil Watson, on behalf of Pendle Borough Council, by a letter dated 1 June 2020. Pendle Borough Council's representative for the contract was John Halton. Hannah Bishop and Mike Williamson of JBA Consulting carried out this work.

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Purpose

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JBA Consulting has no liability regarding the use of this report except to Pendle Borough Council.

Acknowledgements

JBA would like to thank representatives of Pendle Borough Council, Lancashire County Council, the Environment Agency, United Utilities and Yorkshire Water Services for information provided to inform this assessment.

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Executive summary

This Level 1 Strategic Flood Risk Assessment (SFRA) is an update to the existing Level 1 SFRA from 2006, which was refreshed in 2017. It uses up-to-date flood risk information together with the most-current flood risk and planning policy available from the National Planning Policy Framework[1] (NPPF) (2021) and Flood Risk and Coastal Change Planning Practice Guidance[2] (FRCC-PPG).

The Level 1 SFRA is focused on collecting readily available flood risk information from a number of stakeholders. The aim is to help identify the number and spatial distribution of flood risk sources present throughout the Borough of Pendle to inform the application of the Sequential Test.

Pendle Borough Council (PBC) requires this Level 1 SFRA to initiate the sequential risk-based approach to the allocation of land for development and to identify whether application of the Exception Test is likely to be necessary. This will help to inform and provide the evidence base for the Local Planning Authority's (LPA) review of the Local Plan.

The LPA provided its latest assessed sites data and information. As assessment of flood risk to all assessed sites is provided to assist the LPA in its decision-making process for sites to take forward as part of the review of the Local Plan.

A number of PBC's possible development sites are shown to be at varying risk from fluvial, surface water and residual risk. Development consideration assessments for all assessed sites are summarised through a number of strategic recommendations within this report and the development sites assessment spreadsheet in Appendix C. The strategic recommendations broadly entail the following:

- Strategic Recommendation A – consider withdrawal based on significant level of fluvial or surface water flood risk (if development cannot be directed away from areas of risk);
- Strategic Recommendation B – Exception Test required, if site passes the Sequential Test;
- Strategic Recommendation C – consider detailed site layout and design around the identified flood risk if site passes Sequential Test i.e. redrawing of development boundaries to remove risk or incorporation of risk through appropriate mitigation techniques;
- Strategic Recommendation D – site-specific Flood Risk Assessment required as a minimum; and
- Strategic Recommendation E – subject to consultation with the LPA and LLFA, the site could be allocated or permitted for development on flood risk grounds due to little perceived risk.

Possible development sites

A total of 303 sites were screened against the latest available flood risk information. The majority of the sites were residential at 221 with smaller numbers of other uses: 29 employment, 33 mixed use, 1 community housing, 1 community school, 2 community car park, 1 retail, 5 open space, 9 environment and 1 hotel.

Following the flood risk screening, 41 sites are recommended as being potentially unsuitable for development, 12 of which is due to their location within the functional

[1] https://www.gov.uk/government/publications/national-planning-policy-framework--2
[2] https://www.gov.uk/guidance/flood-risk-and-coastal-change

floodplain, and 39 out of the 41 sites being subject to significant surface water flood risk.

There are 4 sites to which Strategic Recommendation B applies of which all have an indicative residential use. Overall there are 67 potential sites to which Strategic Recommendation C applies. Of these sites, 32 have over 97% within Flood Zone 1, meaning surface water is the main source of risk requiring mitigation at these sites. For these sites, the developer should carefully consider site layout and design with a view to removing the development site footprint from the flood zone that is obstructing development i.e. the high and medium risk surface water flood zones. If this is not possible then the alternative would be to investigate the incorporation of temporary on-site storage of water during a rainfall event into the site design through appropriate Sustainable Drainage Systems (SuDS), following detailed ground investigation.

Strategic Recommendation D applies to 130 sites with 109 of these sites being wholly within Flood Zone 1. Strategic Recommendation E applies to 61 sites.

See Appendix C for a full breakdown of the risk to each site and Appendix E which discusses the identified risks.

SFRA Recommendations

The main planning policy and flood risk recommendations to come out of this SFRA are outlined briefly below and are based on the fundamentals of the National Planning Policy Framework and the Flood Risk and Coastal Change Planning Practice Guidance. Section 8.2 of this report provides further detail.

SFRA recommendation:

- No development within the functional floodplain, unless development is water compatible;
- Surface water flood risk should be considered with equal importance as fluvial risk;
- The sequential approach must be followed in terms of site allocation and site layout;
- Ensure site-specific Flood Risk Assessments are carried out to a suitable standard in accordance with national guidance as a minimum, where required, with full consultation required with the LPA, LLFA, the EA, United Utilities (UU), Yorkshire Water Services (YWS), and the Earby and Salterforth Internal Drainage Board (IDB) where applicable;
- Ensure a Sustainable Drainage Strategy is provided for developments in which consideration is given to appropriate SuDS components, the design, adoption and lifetime maintenance of the SuDS at the earliest outset of development discussions, with full consideration required with the LPA, LLFA, the EA, UU and YWS;
- SuDS (which may incorporate Natural Flood Management techniques) must be considered, where appropriate, for mitigation;
- Phasing of development must be carried out to avoid possible cumulative impacts, and consideration given to the on-site management of water during each of development phase; and
- Planning permission for at risk sites can only be granted by the LPA following a site-specific FRA and suitable Sustainable Drainage Strategy, with full consultation required with the LPA, LLFA, the EA, UU, YWS, and Earby and Salterforth IDB were applicable.

Included within this Level 1 SFRA, along with this main report, are:

- Flood risk policy and planning framework – Appendix A;

- Detailed interactive GeoPDF maps showing all available flood risk information together with the assessed sites – Appendix B;
- Development site assessment spreadsheet detailing the risk to each site with recommendations on development – Appendix C;
- A note on the delineation of the functional floodplain following discussion and agreement between PBC and the EA – Appendix D;
- Section explaining the strategic recommendations of the proposed sites – Appendix E;
- Figures showing the proposed sites with their strategic recommendation – Appendix F; and
- A User Guide for the SFRA – Appendix G.

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Abbreviations

AAP	Area Action Plan
ABD	Area Benefitting from Defences
ACDP	Area with Critical Drainage Problems
AEP	Annual Exceedance Probability
BGS	British Geological Survey
CaBA	Catchment Based Approach
CC	Climate change
CDA	Critical Drainage Area
CFMP	Catchment Flood Management Plan
DPD	Development Plan Documents
DRN	Detailed River Network
DTM	Digital Terrain Model
EA	Environment Agency
FAA	Flood Alert Area
FAS	Flood Alleviation Scheme
FCDPAG	Flood and Coastal Defence Project Appraisal Guidance
FCERM	Flood and Coastal Erosion Risk Management Network
FCRMS	Flood and Coastal Risk Management Strategy
FDGiA	Flood Defence Grant in Aid
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
FRCC-PPG	Flood Risk and Coastal Change Planning Practice Guidance
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
FRMS	Flood Risk Management Strategy
FRR	Flood Risk Regulations
FSA	Flood Storage Area
FWA	Flood Warning Area
FWMA	Flood and Water Management Act
GI	Green Infrastructure
GIS	Geographical Information Systems
HFM	Historic Flood Map
IDB	Internal Drainage Board
LA	Local Authority
LASOO	Local Authority SuDS Officer Organisation
LCC	Lancashire County Council
LDF	Local Development Framework
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LRF	Local Resilience Forum
MAFRP	Multi-Agency Flood Response Plan
MHCLG	Ministry of Housing, Communities and Local Government

NFM	Natural Flood Management
NGO	Non-Governmental Organisation
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
PBC	Pendle Borough Council
PCPA	Planning and Compulsory Purchase Act
PFRA	Preliminary Flood Risk Assessment
RBD	River Basin District
RBMP	River Basin Management Plan
RFO	Recorded Flood Outlines
RFCC	Regional Flood and Coastal Committee
RoFSW	Risk of Flooding from Surface Water map
RMA	Risk Management Authority
RoFRS	Risk of Flooding from Rivers and the Sea Map
SA	Sustainability Appraisal
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection
SPD	Supplementary Planning Documents
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKCP09	UK Climate Projections 2009
UKCP18	UK Climate Projections 2018
UU	United Utilities
WCS	Water Cycle Study
WFD	Water Framework Directive
WwNP	Working with Natural Processes
YWS	Yorkshire Water Services

1 Introduction

1.1 Commission

Pendle Borough Council (PBC) commissioned JBA Consulting by a letter dated 1st June 2020 for the undertaking of a Level 1 Strategic Flood Risk Assessment (SFRA) to update the existing Level 1 SFRA from 2006, which was refreshed in 2017. PBC requires this updated Level 1 SFRA to screen and assess flood risk to potential Local Plan development site allocations and to provide strategic recommendations and the evidence to inform the Sequential Test and, where necessary, the Exception Test. This will provide the evidence to support strategic flood risk policies and site allocations in the Local Plan.

1.2 Strategic Flood Risk Assessment

PBC is a Local Planning Authority (LPA) and Lancashire County Council is a Lead Local Flood Authority (LLFA). All LPAs should produce a level 1 SFRA. A level 2 SFRA may also be required depending on whether the Local Authority has plans for development in flood risk areas, identified in the Level 1 SFRA. The Environment Agency's SFRA guidance for local planning authorities[3] (updated September 2020, at the time of writing) states:

"Your SFRA will help your planning authority make decisions about:

- your local plan or spatial development strategy
- individual planning applications
- how to adapt to climate change
- future flood management
- emergency planning (the resources needed to make development safe)

You also need it to help you:

- *carry out the sequential test for the local plan or spatial development strategy, and individual planning applications*
- *do the exception test, when you're proposing to allocate land for development in flood risk areas*
- *establish if a development can be made safe without increasing flood risk elsewhere*
- *decide when a flood risk assessment will be needed for individual planning applications*
- *identify if proposed development is in functional floodplain*
- *do the sustainability appraisal of the local plan or spatial development strategy."*

1.3 Pendle Level 1 SFRA

This SFRA has been carried out in accordance with Government's latest development planning guidance including the revised National Planning Policy Framework (NPPF) (2021) and flood risk and planning policy guidance, the Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG) (last updated March 2014, at the time of writing).

[3] https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment#level-2-strategic-flood-risk-assessment

The latest guidance is available online via:

http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change

An updated version of the NPPF was published on 20 July 2021 and sets out Government's planning policies for England and how these are expected to be applied. This revised Framework replaces the previous versions of the NPPF published in March 2012, July 2018 and December 2019 and is available via:

https://www.gov.uk/government/publications/national-planning-policy-framework--2#history

This SFRA assesses the spatial distribution of flood risk across the local authority area, and provides the discussion and guidance required to put this information into practice when taking account of flood risk in development plans and the level of detail required to carry out site specific Flood Risk Assessments (FRAs).

This SFRA makes use of the most up-to-date flood risk datasets, available at the time of submission, to assess the extent of risk, at a strategic level, to potential development allocation sites identified by PBC. The SFRA appendices contain interactive GeoPDF maps (Appendix B) showing the potential development site allocations overlaid with gathered flood risk information along with a Development Site Assessment spreadsheet (Appendix C) indicating the level of flood risk to each site following a strategic assessment of risk. Each potential site is assigned a strategic recommendation, discussed in Section E.2 of Appendix E. This information will allow the LPA to identify the strategic development options that may be applicable to each site and to inform on the application of the Sequential Test.

1.4 Aims and objectives

The aims and objectives of this Level 1 SFRA, as advised by the NPPF (2021) and FRCC-PPG, EA SFRA guidance (2020) and more specifically included in PBC's Brief document, are to:

- Ensure the SFRA is up to date with the NPPF (2021), the FRCC-PPG (2014) and the EA's updated guidance on preparing SFRAs (2020).
- Form part of PBC's Local Plan Part 2 (LP2) (see Section 4.2) evidence base to ensure that flood risk is fully taken into account when considering allocation options and in the preparation of plan policies, including policies for flood risk management to ensure that flood risk is not increased. The Sustainability Appraisal of the local plan should be updated in line with the SFRA.
- Determine the variations in risk from all sources of flooding across the Borough including:
    - Fluvial from main rivers and ordinary watercourses (Flood Map for Planning and functional floodplain),
    - Surface water (pluvial and sewer),
    - Groundwater,
    - Residual risk from reservoirs and canals,
- Determine the risks to and from surrounding areas in the same flood catchment. Historic flood risk and the effects of climate change (using EA allowances) will also be assessed along with flood risk management, defence infrastructure and flood warning.
- Carry out a screening of all potential development sites against all available sources of flood risk.

- Assist PBC in applying the Sequential Test and, if applicable, identifying those sites requiring the Exception Test and subsequent Level 2 assessment.
- Identify the requirements for site-specific flood risk assessments in particular locations, including those at risk from sources other than river flooding.
- Determine the acceptability of flood risk in relation to emergency planning capability, in particular safe access and egress from new developments.
- Assess flood defence infrastructure, including defence types, Standards of Protection, condition as per T98 specifications, Areas Benefitting from Defences and associated residual risk.
- Consider opportunities to reduce flood risk to existing communities, infrastructure and developments through better management of surface water, provision for conveyance, storage of floodwater through appropriate SuDS and possible critical drainage areas. Also, through natural flood management and the use of blue-green infrastructure or open space that could be used for flood storage and other multi-functional benefits e.g. biodiversity.
- Review locations where additional development may significantly increase flood risk elsewhere (cumulative impacts) and where development pressures may require the Exception Test to be applied (i.e. where a Level 2 assessment is needed).
- Recommend possible flood mitigation solutions that may be integrated into site design (by the developer) to minimise risk to property and life (in accordance with the NPPF Exception Test) where flood risk has been identified as a potential constraint to future development.
- Provide a reference and policy document to advise and inform the general public and private and commercial developers of their obligations under the latest planning guidance.
- Enable the SFRA to be used as a tool to inform the Development Management process about the potential risk of flooding associated with future planning applications and the basis for requiring site-specific FRAs where necessary.

1.5 Consultation

The EA's 2020 SFRA guidance recommends consultation with the following parties, external to PBC:

- the EA
- the LLFA
- emergency planners
- emergency services
- water and sewerage companies
- reservoir owners or undertakers, if relevant
- internal drainage boards, if relevant
- highways authorities
- district councils
- regional flood and coastal committees

1.6 SFRA future proofing

This SFRA has been developed using the most up-to-date data and information available at the time of submission. The SFRA has been future proofed as far as possible though the reader should always confirm with the source organisation (PBC) that the latest information is being used when decisions concerning development and flood risk are being considered. The FRCC-PPG, alongside the NPPF, is referred to throughout this SFRA, being the current primary development and flood risk guidance information available at the time of the finalisation of this SFRA.

The EA's 2020 SFRA guidance states a review of a SFRA should be carried out when there are changes to:

- the predicted impacts of climate change on flood risk
- detailed flood modelling - such as from the EA or LLFA
- the local plan, spatial development strategy or relevant local development documents
- local flood management schemes
- flood risk management plans
- shoreline management plans
- local flood risk management strategies
- national planning policy or guidance

The SFRA should also be reviewed after a significant flood event.

Where possible, the SFRA should be kept as a 'live' entity and continually updated when new information becomes available. The EA's 2020 SFRA guidance requests for reports and maps to be published online and easily updateable, when required.

This SFRA uses the EA's Flood Map for Planning version issued in July 2020 to assess fluvial risk to potential development sites. The Flood Map for Planning is updated at quarterly intervals by the EA, as and when new modelling data becomes available. The reader should therefore refer to the online version of the Flood Map for Planning to check whether the flood zones may have been updated since July 2020, via the following link:

https://flood-map-for-planning.service.gov.uk/

To assess surface water risk to potential sites, this SFRA uses the EA's Risk of Flooding from Surface Water (RoFSW) dataset, last updated March 2020. This dataset is updated periodically when applicable local surface water modelling is carried out. The reader should therefore refer to the online version of the RoFSW map to check whether the surface water flood outlines have been updated, via the following link:

https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

2 Study area

The study area for this SFRA is defined by the administrative boundary of PBC located in north-eastern Lancashire and covers an area of approximately 169 km^2. In 2016, the population was an estimated 90,588. It is bounded to the west and north by the Lancashire districts of Burnley and Ribble Valley. To the east is the district of Craven in North Yorkshire and to the south the West Yorkshire districts of Bradford and Calderdale.

In the late 19th century excellent communication links and the availability of natural resources, in the form of coal and water, were the catalyst for a period of rapid, and largely unplanned, industrial and urban growth. Almost overnight the area was transformed as once quiet villages evolved into industrial towns. The local population increased from just 10,000 to over 70,000 by the turn of the century. The historic environment is now one of the borough's key attractions, but the Victorian civic infrastructure is often not fit for purpose or in need of repair

In the urban areas, undersized or blocked culverts have contributed to flooding in the past. In rural areas, surface water runoff from agricultural land is a downstream risk. Fluvial flooding in the valley bottoms from Pendle Water, Colne Water, Stock Beck and Earby Beck poses the greatest risk, although heavy summer thunderstorms have also caused localised flooding incidents. The Leeds and Liverpool Canal and a number of reservoirs also represent a potential flood risk.

The borough sits astride the Pennine watershed and is located within the River Ribble, River Aire, and River Calder catchments. The majority of watercourses in Pendle lie to the west of the Pennine watershed. They ultimately form part of the River Ribble catchment and drain into the Irish Sea. To the east of the Pennine watershed, a small number of rivers and streams form part of the catchments for the River Aire and River Calder (Yorkshire). In both cases they drain into the North Sea via the Humber estuary. In the north, in largely rural West Craven, the market town of Barnoldswick sits within the Ribble catchment, whilst the nearby villages of Earby and Kelbrook lie across the Pennine watershed and within the catchment of the River Aire. Approximately one-fifth of all new development in Pendle up to 2030 is anticipated to take place in this part of Pendle. In the south-east corner of the borough, several small streams drain the upland moors around Watersheddles Reservoir. These flow into the River Worth before joining the River Aire at Keighley. A few small tributaries of Hebden Water rise on southern slopes of Boulsworth Hill just within the PBC boundary. They eventually flow into Hebden Water, which joins the River Calder (Yorkshire) at Hebden Bridge; a small market town that is highly susceptible to flooding following periods of high rainfall. No new development is anticipated in this part of the Borough.

The largest catchment in the borough is that for the River Calder (Lancashire), which includes the settlements of Nelson, Colne, Brierfield and Barrowford. These lie within the M65 Corridor spatial area, where development pressure in the borough is at its highest.

The study area falls within the North West and Humber River Basin Districts (RBD) and is served by United Utilities (UU) and Yorkshire Water Services (YWS).

Geology and Topography

Lancashire was completely covered by ice during the last Ice Age. As a consequence, the solid geology is largely covered by layers of glacially derived sediments. These form a skin of superficial deposits, or till, which in places are so thick as to eradicate all visual clues as to the nature of the underlying solid geology.

In Pendle, Carboniferous Millstone Grit (a coarse sandstone) forms the hills that almost completely encircle Pendle. Overlain by extensive peat deposits, the remote gently rolling upland landscapes host a mosaic of wildlife habitats and support

important breeding colonies for many upland birds. They are also important water catchment areas, with numerous small watercourses feeding the many reservoirs.

The Millstone Grit Formation is underlain by the Upper Bowland Shale Formation, the resistant Pendleside Sandstone and the Lower Bowland Shale Formation respectively, their outcrops being marked by noticeable changes in slope. The lower slopes are overlain by thick deposits of glacial drift, mainly boulder clay of low permeability. The underlying geology and overlying soils tend to generate rapid flow to watercourses. Alluvium and terrace deposits found along the course of Pendle Water and its tributaries can act as minor aquifers.

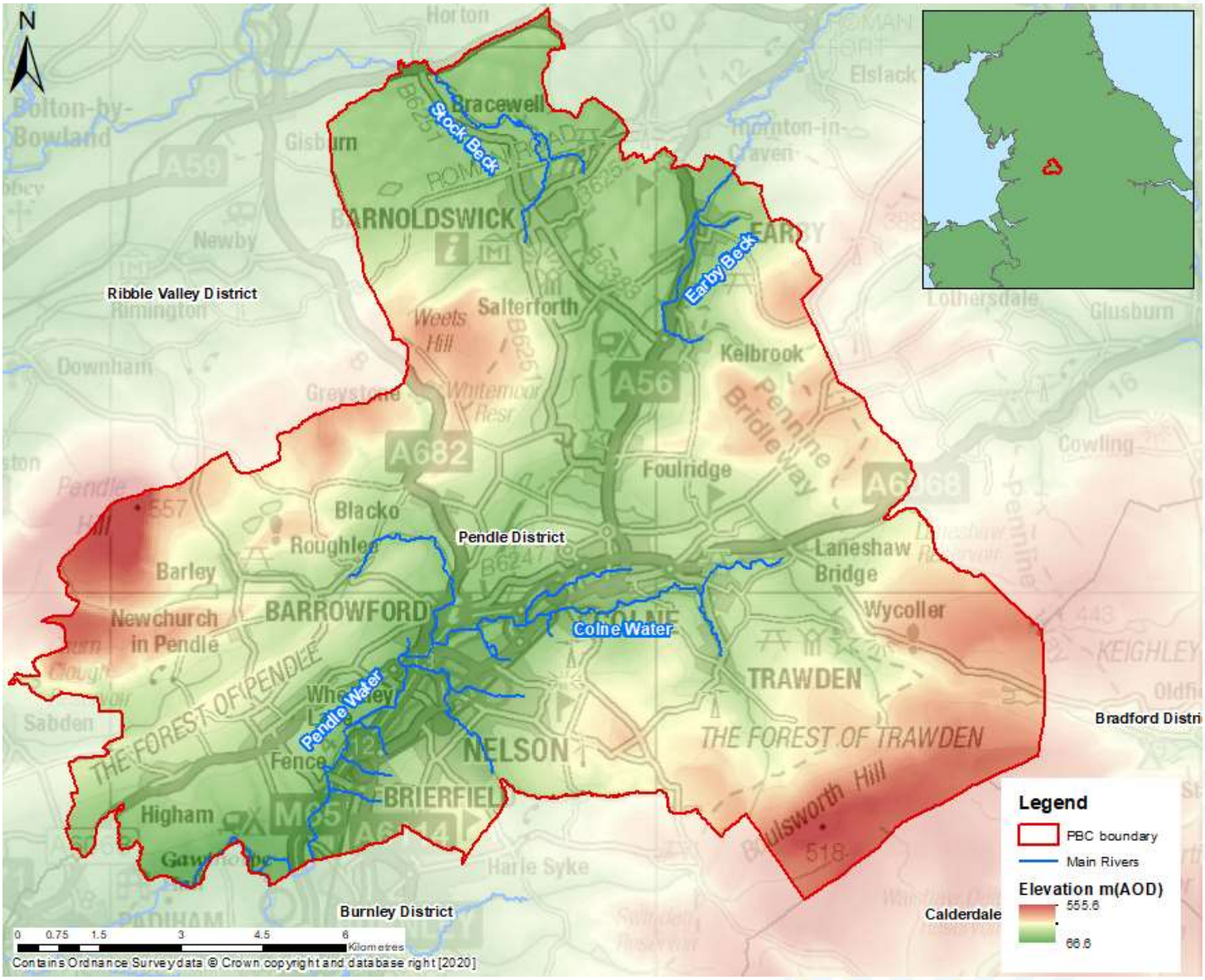

Figure 2-1: Study area

2.1 Main rivers

Main rivers are usually larger rivers and streams. The EA has permissive powers to carry out maintenance, improvement or construction work on main rivers to manage flood risk. The EA also regulate development or works on, over, under or within 8 metres of fluvial main river watercourses (16 metres for tidal main river

watercourses) under the Environmental Permitting (England and Wales) Regulations 2016. This also includes within the floodplain, if the works do not have planning permission and works involving quarrying or excavation within 16 metres of any main river, flood defence or culvert. The range of activities subject to regulation are listed at:

https://www.gov.uk/guidance/flood-risk-activities-environmental-permits#check-if-the-activity-is-on-a-main-river

While the EA has permissive powers to undertake works, the maintenance of Main Rivers is primarily the responsibility of riparian owners.

The PBC area contains the Main Rivers of Pendle Water and Colne Water in the south and Stock Beck and Earby Beck in the north. In total excluding the very small feeder channels found in many headwaters, the borough has 156 discernible watercourses of which 24 have section classified as Main River, covering a total length of approximately 66.4 km.

2.1.1 Pendle Water

Pendle Water cuts a deep valley between Barley Moor and Spence Hill where it feeds into the Upper and Lower Ogden Reservoirs. It drains the steep eastern slopes of Pendle Hill, above Barley, flows initially southeast, and then southwest after confluence with Colne Water. It continues to a confluence with the River Calder near Burnley, which has a history of flooding in Padiham and Whalley. The catchment responds rapidly to rainfall events.

2.1.2 Colne Water

Collects flow from several steep becks in the southeast of the borough, then flows west to a confluence with Pendle Water. The tributaries are likely to respond rapidly to rainfall events.

2.1.3 Stock Beck

A minor river in the West Craven area of Pendle that is 8.25 miles (13.27 km) long and has a catchment area of 14.41 sq miles. Rising as Calf Hall Beck near Higher Laithe Farm, it flows north east into Barnoldswick, where it meets Gillians Beck and turns north becoming Butts Beck. Stock Beck leaves the town before heading northwater to meet Fools Syke and Hell Forest Dike near Gilbeber Hill. Eventually, it passes under the Stock Beck viaduct on the Ribble Valley line and the A682 Long Preston Road, north of the village of Gisburn and joins the River Ribble at Gisburne Park.

2.1.4 Earby Beck

A watercourse in the northeast of Pendle with a large catchment area comprising mainly of grit, sandstone and shale with boulder clay and peat. The catchment responds rapidly to rainfall events.

2.2 Ordinary watercourses

Ordinary watercourses are any watercourse that is not designated as a Main River. These watercourses can vary in size considerably and can include rivers, streams and all ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers within the meaning of the Water Industry Act 2014) and passages, through which water flows. Ordinary watercourses do not always contain flowing water all year long; there may be times where the watercourses run dry, particularly over prolonged dry spells.

Ordinary watercourses come under the regulation of the LLFA, which has permissive powers to carry out works, should this be deemed necessary, and have regulatory

control over certain development activities within the watercourse channel. However, the responsibility for the maintenance of Ordinary Watercourses lies with the riparian owner. A riparian owner is anyone who owns a property where there is a watercourse within or adjacent to the boundaries of their property; they are responsible for watercourses or culverted watercourses passing through their land.

3 Understanding flood risk

3.1 Sources of flooding

Flooding is a natural process and can happen at any time in a wide variety of locations, as discussed below. It constitutes a temporary covering of land not normally covered by water and presents a risk when 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 (also see Figure 3-1) include:

- **Fluvial** (main rivers and ordinary watercourses) – 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 (not applicable to the Borough of Pendle).
- **Surface water** – surface water flooding covers two main sources including direct run-off from adjacent land (pluvial) and surcharging of piped drainage systems (public sewers, highways 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.

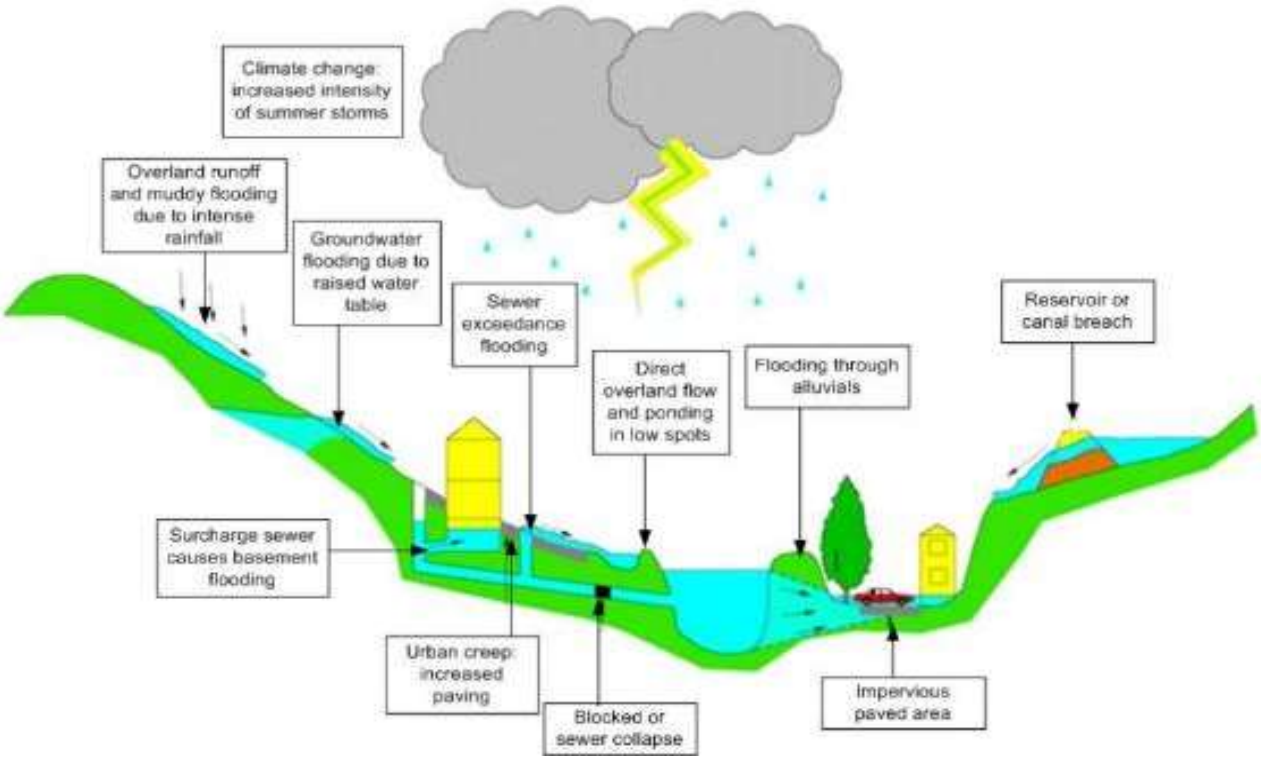

Figure 3-1: Flooding from all sources

3.2 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 3-2 below. This is a standard environmental risk model common to many hazards and should be the starting point of any assessment of flood risk. However, it should be remembered that flooding could occur from many different sources and pathways, and not simply those shown in the illustration below.

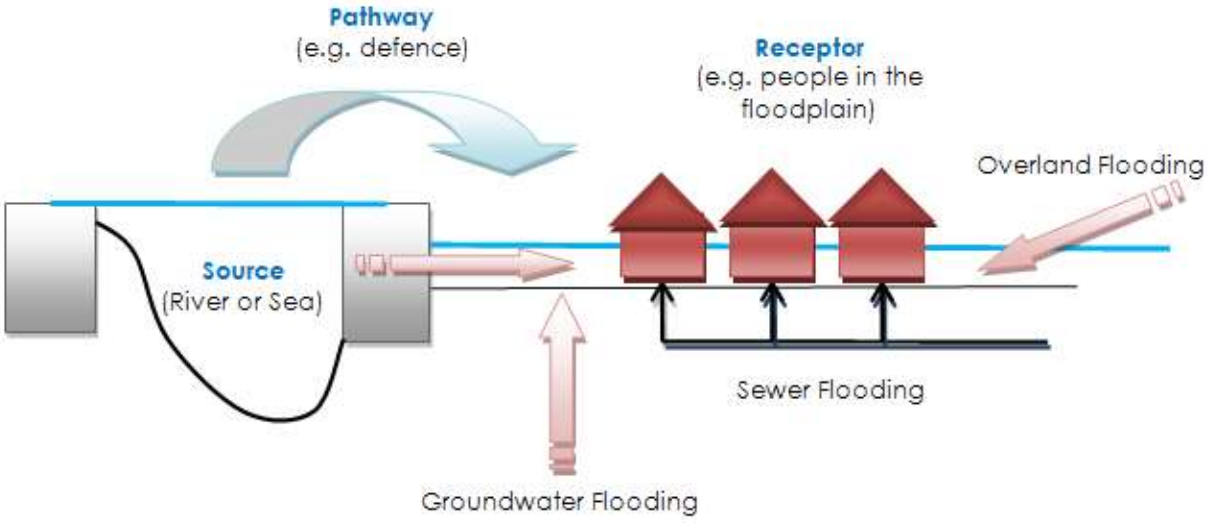

Figure 3-2: Source-Pathway-Receptor Model

The principal sources are rainfall or higher than normal sea levels (though not in the Borough). 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.

3.2.1 Likelihood

The 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 in 100 AEP (Annual Exceedance Probability) events indicates the flood level that is expected to be reached on average once in a hundred years, i.e. it has a 1 in 100 AEP event of occurring in any one year, not that it will occur once every one hundred years.

Table 3-1 provides an example of the flood probabilities used to describe the fluvial and tidal flood zones as defined in the FRCC-PPG and as used by the EA in their Flood Map for Planning (Rivers and Sea).

Note that the flood zones shown on the Flood Map for Planning do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding. The Flood Map for Planning can be accessed via:

https://flood-map-for-planning.service.gov.uk/

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)

Zone 3b The Functional Floodplain	**This zone comprises land where water has to flow or be stored in times of flood.** Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone3a on the Flood Map)

Table 3-1: NPPF flood zones[4]

[4] Table 1: Flood Zones, Paragraph 065 of the Flood Risk and Coastal Change Planning Practice Guidance

3.2.2 Consequence

The consequences of flooding include property damage, disruption to lives and businesses, with severe implications for people (e.g. fatalities, 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

3.3 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.

3.3.1 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. However, the residual risk may be high in that the impact of flood defence failure would likely have a major impact.

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.

3.3.2 Residual risk

Defended areas, located behind EA, LCC and privately owned flood defences, remain at residual risk as there is a risk of overtopping or defence breach during significant flood events. Whilst the potential risk of failure may be reduced, consideration of inundation and the impact on development needs to be considered.

Paragraph 041 of the FRCC-PPG defines residual risk as:

"…those remaining after applying the sequential approach to the location of development and taking mitigating actions. Examples of residual flood risk include:

- *The failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system, overtopping of an upstream storage area, or failure of a pumped drainage system;*
- *failure of a reservoir, or;*
- *a severe flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defence, or an intense rainfall event which the drainage system cannot cope with.*

Areas behind flood defences are at particular risk from rapid onset of fast-flowing and deep-water flooding, with little or no warning if defences are overtopped or breached."

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".

Developers must be able to demonstrate that development will be safe for the lifespan of the development. To that end, Paragraph 042 of the FRCC-PPG states:

"Where residual risk is relatively uniform, such as within a large area protected by embanked flood defences, the Strategic Flood Risk Assessment should indicate the nature and severity of the risk remaining, and provide guidance for residual risk issues to be covered in site-specific flood risk assessments. Where necessary, local planning authorities should use information on identified residual risk to state in Local Plan policies their preferred mitigation strategy in relation to urban form, risk management and where flood mitigation measures are likely to have wider sustainable design implications".

Table 5-5 (Section 5.7.1) lists the main EA defences in the PBC area and Table 5-6 lists the Areas Benefitting from Defences (ABD). The EA defences and ABD dataset are also shown on the SFRA maps in Appendix B.

Residual flood risk from breach or overtopping of defences must be managed for any new development. This could be achieved by ensuring floor levels are raised a minimum of 600 mm above the critical design event flood level whilst also accounting for freeboard (as advised by the EA). However, compensatory storage must be found where the risk is fluvial. If this cannot be achieved, it is for the applicant to identify alternative mitigation measures. Stilted development is an option whereby floodwaters can still flow naturally though this can prove to be a costly solution. Any site identified to be at residual risk must have suitable site access and egress routes available during times of flood together with a full emergency plan that should accompany the FRA at the application stage. The provisions of suitable flood warning systems should also be investigated.

Detailed mitigation must be agreed through site-specific FRAs or through Level 2 SFRAs where it would be necessary to demonstrate site allocations would be safe for their lifetime.

Chapter 6 discusses various mitigation measures that may be appropriate depending on the site-specific circumstances.

4 The planning framework and flood risk policy

4.1 Introduction

The main purpose of this section of the SFRA is to provide an overview of the key planning and flood risk policy documents that have shaped the current planning framework. This section also provides an overview and context of the LLFA's and LPA's responsibilities and duties in respect to managing local flood risk including but not exclusive to the delivery of the requirements of the Flood Risk Regulations (FRR) 2009 and the Flood and Water Management Act (FWMA) 2010.

Figure 4-1

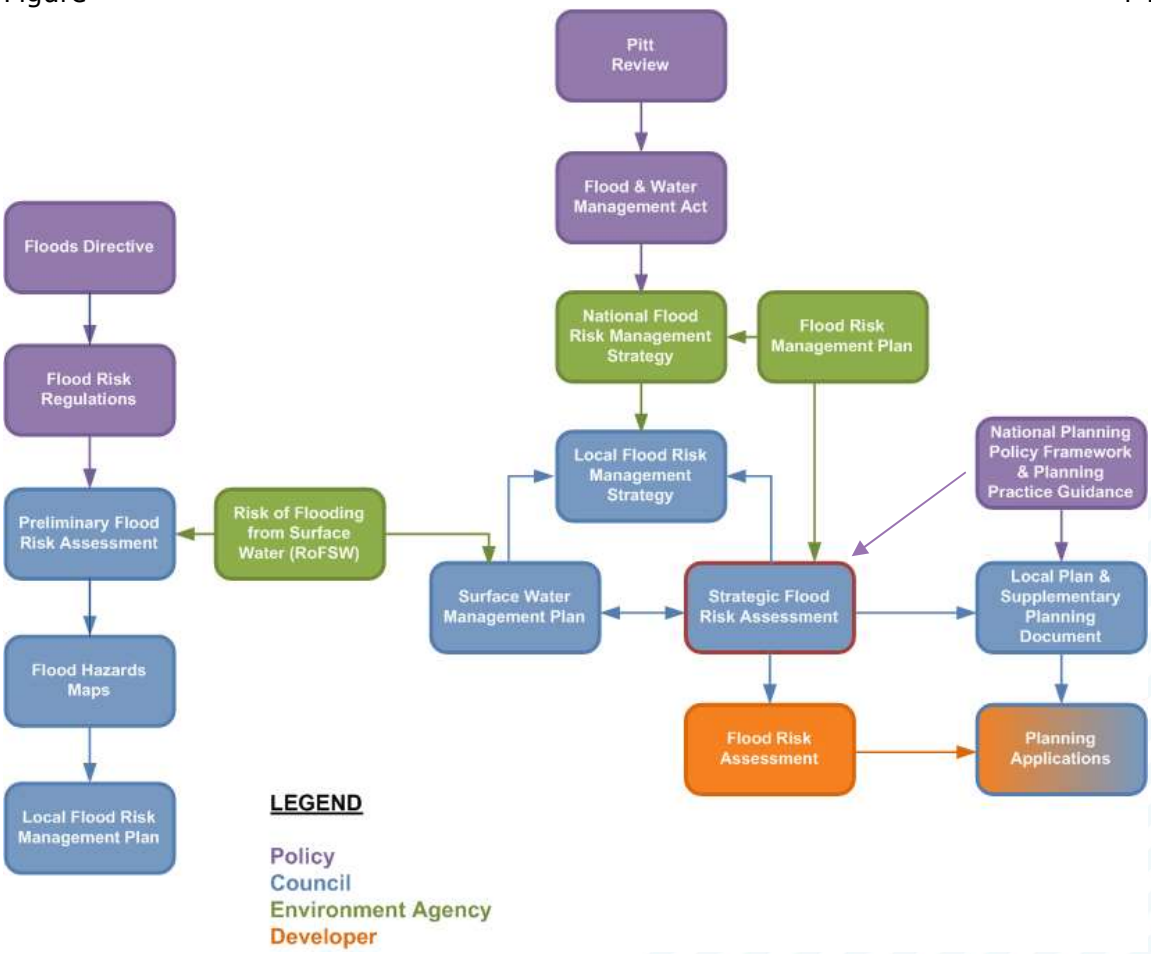

Figure 4-1illustrates the links between legislation, national policy, statutory documents, and assessment of flood risk. The figure shows that whilst the key pieces of legislation and policy are separate, they are closely related, and their implementation should aim to provide a comprehensive and planned approach to asset record keeping and improving flood risk management within communities.

It is intended that the non-statutory Surface Water Management Plans (SWMPs) and SFRAs can provide much of the base data required to support the delivery of the LLFA's statutory flood risk management tasks as well supporting local authorities in developing capacity, effective working arrangements and informing Local Flood Risk Management Strategies (LFRMS) and Local Plans, which in turn help deliver flood risk management infrastructure and sustainable new development at a local level. This SFRA should be used to support the LPA's emerging Local Plan and to help inform planning decisions.

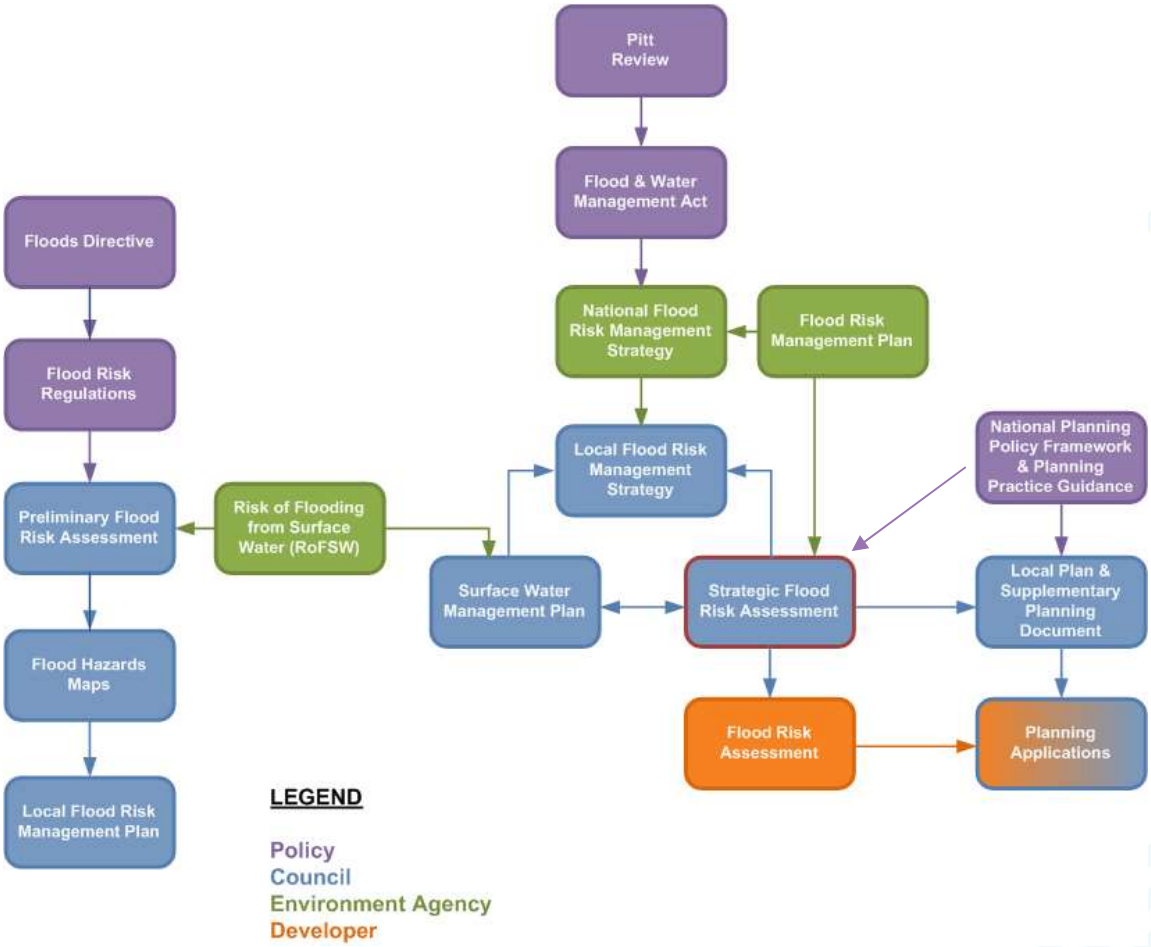

Figure 4-1: Key documents and strategic planning links with flood risk

4.2 Pendle Local Plan[5]

The Pendle Local Plan sets out a vision and a framework for the future development of the area. It addresses needs and opportunities in relation to housing, the economy, community facilities and infrastructure – as well as providing a basis for safeguarding the environment, adapting to climate change and securing good design. It is used by planning officers to guide decisions about individual development proposals and it forms the starting point for considering whether an application for planning permission should be approved, together with any neighbourhood plans that have been made (adopted).

The Local Plan is a two-part document:

- Pendle Local Plan Part 1: Core Strategy (LP1), was adopted in December 2015. It outlines the amount and broad location of development in the Borough up to 2030.
- Pendle Local Plan Part 2: Site Allocations and Development Policies (LP2) will include detailed planning policies setting out specific requirements for new development in the borough and offering guidance for officers responsible for determining applications for planning permission. It will also allocate sufficient land to meet the development requirements established in LP1 and designate

[5] https://www.pendle.gov.uk/info/20072/planning_policies/273/local_plan

land to be protected from inappropriate development because of its value to the natural or historic environment.

The main policy from the Core Strategy that relates to flood risk is Policy ENV7: Water Management[6].

The remaining flood risk policy information relevant to this study is located in Appendix A.

[6] https://www.pendle.gov.uk/downloads/file/8723/pendle_local_plan_part_1_core_strategy

5 Flood risk across Pendle Local Plan Area

5.1 Flood risk datasets

This section of the SFRA provides a strategic overview of flood risk from all sources within Pendle. The information contained is the best available at the time of publication and is intended to provide PBC with an overview of risk. Table 5-1 provides a summary of the key datasets used in this SFRA according to the source of flooding.

Flood Source	Datasets / Studies
Fluvial	EA Flood Map for Planning (Rivers and Sea) (downloaded July 2020)
	EA Risk of Flooding from Rivers and Sea map
	Modelled Flood Outlines (MFO) from latest available EA Flood Risk Mapping Studies
	EA Historic Flood Map (HFM) (July 2020)
	EA Recorded Flood Outlines (RFO) (July 2020)
	EA Areas Benefitting from Flood Defences (ABD) (July 2020)
	EA Flood Warning Areas (July 2020)
Pluvial (surface water runoff)	EA Risk of Flooding from Surface Water (RoFSW)
	LCC Preliminary Flood Risk Assessment 2011 and update 2017
Sewer	Yorkshire Water Historical Flood Incident Data
	United Utilities Historical Flood Incident Data
Groundwater	BGS Groundwater data
Reservoir	EA Reservoir Flood Maps (available online)
All sources	Humber Flood Risk Management Plan 2015 to 2021
	North West Flood Risk Management Plan 2015 to 2021
	Humber River Basin Management Plan (June 2018)
	North West River Basin Management Plan (June 2018)
	Ribble Catchment Flood Management Plan (2009)
	Aire and Calder Catchment Flood Management Plan (2009)
	Lancashire and Blackpool Local Flood Risk Management Strategy (2014)
	PBC Level 1 SFRA (2006, updated 2017)
Flood risk management infrastructure	EA Spatial Flood Defence data (July 2020)
	LLFA FRM asset register

Table 5-1: Flood source and key datasets

5.2 Fluvial flooding

Fluvial flooding is associated with the exceedance of channel capacity during higher flows or as a result of blockage. The process of flooding from watercourses depends on a number of characteristics associated with the catchment including geographical location and variation in rainfall; steepness of the channel and surrounding

floodplain; and; infiltration and rate of runoff associated with urban and rural catchments.

The SFRA Maps in Appendix B present the EA's Flood Map for Planning which shows the fluvial coverage of flood zones 2 and 3 across the study area.

5.2.1 EA Flood Map for Planning (Rivers and Sea)

The EA's Flood Map for Planning is the main dataset used by planners for predicting the location and extent of fluvial and tidal flooding. This is supported by the CFMPs and FRMPs along with a number of detailed hydraulic river modelling reports which provide further detail on flooding mechanisms.

The Flood Map for Planning provides flood extents for the 1 in 100 AEP (1%) fluvial event (Flood Zone 3) and the 1 in 1000 AEP (0.1%) fluvial flood events (Flood Zone 2). Flood zones were originally prepared by the EA using a methodology based on the national digital terrain model (NextMap), derived river flows from the Flood Estimation Handbook (FEH) and two-dimensional flood routing. Since their initial release, the EA has regularly updated its flood zones with detailed hydraulic model outputs as part of their national flood risk mapping programme.

The Flood Map for Planning is precautionary in that it does not take account of flood defence infrastructure (which can be breached, overtopped or may not be in existence for the lifetime of the development) and, therefore, represents a worst-case scenario of flooding. The flood zones also do not account for climate change. As directed by the FRCC-PPG, this SFRA subdivides Flood Zone 3 into Flood Zone 3a and Flood Zone 3b (functional floodplain – see Section 5.2.2).

The EA also provides a 'Risk of Flooding from Rivers and Sea Map'. This map shows the EA's assessment of the likelihood of flooding from rivers and the sea, at any location, and is based on the presence and effect of all flood defences, predicted flood levels and ground levels. **This dataset is not used in the assessment of flood risk for planning applications** but is a useful source of information to show the presence and effects of flood risk management infrastructure. This dataset is further discussed in Section 0.

This SFRA uses the Flood Map for Planning issued in July 2020 to assess fluvial risk to the potential development sites, as per the NPPF and the accompanying FRCC-PPG. The Flood Map for Planning is updated at quarterly intervals by the EA, as and when new modelling data becomes available. The reader should therefore refer to the online version of the Flood Map for Planning to check whether the flood zones may have been updated since July 2020:

https://flood-map-for-planning.service.gov.uk/

5.2.2 Functional floodplain (Flood Zone 3b)

The functional floodplain forms a very important planning tool in making space for flood waters when flooding occurs. Development should be directed away from these areas.

Table 1, Paragraph 065 of the FRCC-PPG defines Flood Zone 3b as:

"…land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency."

Paragraph 015 of the FRCC-PPG explains that:

"…the identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood with an annual probability of 1 in 20 (5%) or greater in any year, or is

designed to flood (such as a flood attenuation scheme) in an extreme (0.1% annual probability) flood, should provide a starting point to help identify the functional floodplain.

The area identified as functional floodplain should take into account the presence and effect of all flood risk management infrastructure including defences. Areas which would naturally flood, but which are prevented from doing so by existing defences and infrastructure or solid buildings, will not normally be identified as functional floodplain. If an area is intended to flood, e.g. an upstream flood storage area designed to protect communities further downstream, then this should be safeguarded from development and identified as functional floodplain, even though it might not flood very often."

The EA's most up-to-date Historic Flood Map (HFM), Areas Benefitting from Defences (ABD), Recorded Flood Outlines (RFO) and Flood Storage Areas (FSA) datasets were assessed with regards to using them to create the functional floodplain where appropriate. A technical note is provided in Appendix D which explains the methodology used in creating the functional floodplain outline.

The following MFOs were used to create the functional floodplain:

Model	Year	Return period	Defended?
Brun Calder	2020	20 year	Yes
Colne Water	2020	20 year	No
Edge End Brook	2020	20 year	No
Hollins Mill	2020	20 year	No
North Valley	2020	20 year	Yes
Pendle Water	2020	20 year	No
Primet Water	2020	20 year	No
Swinden Clough	2020	20 year	Yes
Walverden Water	2020	20 year	Yes
Hendon Brook	2018	20 year	N/A
Earby Beck	2018	20 year	Yes

Table 5-2: Modelled Flood Outlines used to create the functional floodplain

As there are no formal defences on Hendon Brook, it is stated as 'Not Applicable' for defences. The functional floodplain outline was assessed and agreed upon by the LPA, the LLFA and the EA, based on their in-depth local knowledge. The methodology note for the delineation of the functional floodplain is located in Appendix D.

5.2.3 EA Risk of Flooding from Rivers and the Sea map

This Risk of Flooding from Rivers and Sea map (RoFRS) shows the likelihood of flooding from rivers and the sea based on the presence and effect of all flood defences, predicted flood levels and ground levels and is shown on the Appendix B maps. The RoFRS map splits the likelihood of flooding into four risk categories:

- High – greater than or equal to 1 in 30 AEP event (3.3%) chance in any given year
- Medium – less than 1 in 30 AEP event (3.3%) but greater than or equal to 1 in 100 AEP event (1%) chance in any given year
- Low – less than 1 in 100 AEP event (1%) but greater than or equal to 1 in 1000 AEP flood event (0.1%) chance in any given year

- Very Low – less than 1000 AEP event (0.1%) chance in any given year

The RoFRS map is included on the SFRA maps to act as a supplementary piece of information to assist the LPA in the decision-making process for site allocation.

This dataset is not suitable for use with any planning application nor should it be used for the sequential testing of site allocations. The EA's Flood Map for Planning should be used for all planning purposes, as per the FRCC-PPG.

5.3 Surface water flooding

Surface water flood risk is afforded equal standing in importance and consideration as fluvial flood risk, given the increase in rainfall intensities due to climate change and the increase in impermeable land use due to development.

Surface water flooding, in the context of this SFRA, includes:

- **Surface water runoff (also known as pluvial flooding); and**
- **Sewer flooding**

There are certain locations, generally within urban areas, where the probability and consequence of pluvial and sewer flooding are more prominent due to the complex hydraulic interactions that exist in the urban environment. Urban watercourse connectivity, sewer capacity, and the location and condition of highway gullies all have a major role to play in surface water flood risk.

Paragraph 013 of the FRCC-PPG states that SFRAs should address surface water flooding issues by identifying areas of surface water flooding and areas where there may be drainage issues that can cause surface water flooding. The EA's Risk of Flooding from Surface Water (RoFSW) map along with information within the LFRMS (see Section A.6.4 of Appendix A) should assist with this and various mitigative measures, i.e. SuDS, should be identified. Sections 6.5 and 6.7 provide guidance on mitigation options and SuDS for developers.

It should be acknowledged that once an area is flooded during a large rainfall event, it is often difficult to identify the route, cause and ultimately the source of flooding without undertaking further site-specific and detailed investigations.

5.3.1 Pluvial flooding

Pluvial flooding of land from surface water runoff is usually caused by intense rainfall that may only last a few hours. In these instances, the volume of water from rural land can exceed infiltration rates in a short amount of time, resulting in the flow of water over land. Within urban areas, this intensity can be too great for the urban drainage network resulting in excess water flowing along roads, through properties and ponding in natural depressions. Areas at risk of pluvial flooding can, therefore, lie outside of the fluvial flood zones.

Pluvial flooding within urban areas across the country will typically be associated with events greater than the 1 in 30 AEP design standard of new sewer systems. Some older sewer and highway drainage networks will have a lower capacity than what is required to mitigate for the 1 in 30 AEP event. There is also residual risk associated with these networks due to possible network failures, blockages or collapses.

Risk of Flooding from Surface Water dataset

The Risk of Flooding from Surface Water (RoFSW), formally referred to as the updated Flood Map for Surface Water (uFMfSW) is the third-generation national surface water flood map, produced by the EA, aimed at helping to identify areas where localised, flash flooding can cause problems even if the Main Rivers are not overflowing. The RoFSW, used in this SFRA to assess risk from surface water, has proved extremely useful in supplementing the EA Flood Map for Planning by

identifying areas in Flood Zone 1, which may have critical drainage problems. However, any sites identified to be at risk from surface water flooding should be assessed in more detail, following this SFRA, as the RoFSW is a national-scale dataset and may therefore overestimate or underestimate risk.

The RoFSW includes surface water flood outlines, depths, velocities and hazards for the following events:

- 1 in 30 AEP event (3.3%) – high risk
- 1 in 100 AEP event (1%) – medium risk
- 1 in 1000 AEP event (0.1%) – low risk

The National Modelling and Mapping Method Statement, May 2013 details the methodology applied in producing the map. The RoFSW is displayed on the SFRA maps.

5.3.2 Sewer flooding

Within the North West, the public sewerage network is made up of around 50% of combined systems, which serve residential homes, and businesses, conveying waste and surface water to waste water treatment works. Combined Sewer Overflows, (CSOs) provide relief of the sewer network during times of heavy rainfall and high flows in the network, through an Environment Agency consented discharge to the environment. If areas are not served by a combined sewer system, they are served by separated foul and surface water sewers which also convey the wastewater to wastewater treatment works and the surface water discharges into the local environment.

There are a number of reasons why flooding from a public sewer network can occur:

1. Hydraulic Incapacity
    a. When the flow entering the network exceeds its design capacity.
    b. Surface water outfalls or CSO outfalls can become restricted due to high water levels in the receiving watercourse, resulting in the water not being to discharge
2. Flooding Other Causes
    a. Flooding can also occur through other means such as a result of a blockage within the sewer, which is defined as sewer misuse
    b. Collapse of the sewer or burst of a rising main, and also mechanical or electrical faults with pumping stations.

United Utilities is the water company responsible for the management of the majority of the drainage networks across the Borough. Some other areas of the Borough are covered by Yorkshire Water.

5.3.3 Areas with Critical Drainage Problems and Critical Drainage Areas

The EA can designate Areas with Critical Drainage Problems (ACDPs). ACDPs may be designated where the EA is aware that development within a certain catchment / drainage area could have detrimental impacts on fluvial flood risk downstream, and / or where the EA has identified existing fluvial flood risk issues that could be exacerbated by upstream activities. In these instances, the EA would work with the LLFA and LPA to ensure that adequate surface water management measures are incorporated into new development to help mitigate fluvial flood risk.

EA guidance on carrying out Flood Risk Assessments[7] states that a FRA should be carried out for sites in Flood Zone 1 that are…

"…in an area with critical drainage problems as notified by the Environment Agency."

This statement refers to sites within an ACDP, not a CDA. At the time of writing there are no ACDPs or CDAs in Pendle.

CDAs can be designated by LPAs or LLFAs for their own purposes. The EA do not have to be consulted on sites that are within a CDA if such sites are in Flood Zone 1.

5.3.4 Locally agreed surface water information

EA guidance, from within the Flood and Water Management Act (FWMA) (2010)[8], on using surface water flood risk information recommends that LCC, as a LLFA, should:

"…review, discuss, agree and record, with the Environment Agency, Water Companies, Internal Drainage Boards and other interested parties, what surface water flood data best represents their local conditions. This will then be known as locally agreed surface water information".

Following on from the LLFA consultation on the RoFSW in 2013 before its release, the EA stated that the Flood Map for Surface Water (2010) and the Areas Susceptible to Surface Water Flooding (2008) maps do not meet the requirements of the Flood Risk Regulations and are not compatible with the 2013 RoFSW mapping. Consequently, these datasets cannot be used as 'locally agreed surface water information'.

Locally agreed surface water information either consists of:

- The RoFSW map, or
- Compatible local mapping if it exists i.e. from a SWMP, or
- A combination of both these datasets for defined locations in the LLFA area.

As there is no LCC-wide SWMP yet published, PBC should consider the RoFSW to be its locally agreed surface water flood information as this is the latest, most robust surface water flood map available for the Borough, at the time of writing.

5.4 Groundwater flooding

In simplistic terms, groundwater flooding occurs when the water table rises and water levels in the ground rise above the surface of the land. Flooding tends to occur after long periods of sustained heavy rainfall and can last for weeks or even months. The areas most at risk are often low lying areas where the water table is more likely to be at a shallow depth and flooding can be experienced through water rising up from the underlying aquifer, or from water flowing from springs. Flooding from groundwater is most common in areas where the underlying bedrock is chalk, but it can also happen in locations with sand and gravel.

The EA's 2020 SFRA guidance recommends the use of the British Geological Survey's (BGS) national dataset on the susceptibility of groundwater flooding. Based on geological and hydrogeological information, the digital data can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface.

The dataset is split into three categories, based on the potential of groundwater flooding occurring:

[7] https://www.gov.uk/guidance/flood-risk-assessment-in-flood-zone-1-and-critical-drainage-areas
[8] https://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf

1. Limited potential for groundwater flooding to occur,
2. Potential for groundwater flooding of property situated below ground level,
3. Potential for groundwater flooding to occur at the surface.

There is currently limited research which specifically considers the impact of climate change on groundwater flooding. The mechanisms of groundwater flooding are unlikely to be affected by climate change, however if winter rainfall becomes more frequent and heavier, groundwater levels may increase. Higher winter recharge may however be balanced by lower recharge during the predicted hotter and drier summers.

Further investigation should be carried out as part of the preparation of a site-specific FRA, for any site deemed to be at risk of groundwater flooding i.e. in BGS categories 2 or 3. The FRA should incorporate a site-based assessment of the potential risk of groundwater flooding to the site, confirming from borehole data whether groundwater is a source of flood risk for the site, and setting out any mitigation measures proposed. Onsite infiltration testing should also be carried out; however, it is unlikely that any areas within these categories would be suitable for infiltration-based SuDS.

Categories 2 and 3 are distributed across the whole of the Borough of Pendle with the main areas including Barnoldswick, Colne, and along the M65.

It is important to ensure that future development is not placed at unnecessary risk therefore groundwater risk should be considered on a site by site basis in development planning.

Groundwater flood risk should be considered particularly when determining the suitability of SuDS components as a way of managing surface water flood risk as part of their Sustainable Drainage Strategy. Developers should consult with the relevant LPA, the LLFA, UU and YWS, and the Earby and Salterforth IDB where applicable at an early stage of the assessment.

The BGS dataset is shown on the SFRA Maps in Appendix B.

5.5 Canal and reservoir flood risk

5.5.1 Canals

Non-natural or artificial sources of flooding can include canals where water is retained above natural ground level. The risk of flooding along a canal is considered to be residual and is dependent on a number of factors. As canals are manmade systems that are heavily controlled, it is unlikely they will respond in the same way as a natural watercourse during a storm event. Flooding is more likely to be associated with residual risks, similar to those associated with river defences, such as overtopping of canal banks, breaching of embanked reaches or asset (gate) failure as highlighted in Table 5-3. Canals can also have a significant interaction with other sources, such as watercourses that feed them and minor watercourses or drains that cross underneath.

Potential Mechanism	Significant Factors
Leakage causing erosion and rupture of canal lining leading to breach	Embankments Sidelong ground Culverts Aqueduct approaches
Collapse of structures carrying the canal above natural ground level	Aqueducts Large diameter culverts Structural deterioration or accidental damage
Overtopping of canal banks	Low freeboard

Potential Mechanism	Significant Factors
	Waste weirs
Blockage or collapse of conduits	Culverts

Table 5-3: Canal flooding

The risks associated with these events are also dependent on their potential failure location with the consequence of flooding higher where floodwater could cause the greatest harm due to the presence of local highways and adjacent property.

The Leeds and Liverpool Canal passes through the Borough in a north-easterly direction. From the west it follows Pendle Water before crossing the Pennine watershed in a mile-long tunnel. After emerging back into daylight it passes beside the headwaters of Earby Beck and Stock Beck before crossing the boundary with Yorkshire as shown below in Figure 5-1. Many small watercourses are culverted beneath the canal, or enter and exit the canal via sluices.

Only one known incident of flooding associated with the canal has been identified. Flooding of a road and several properties was reported in Salterforth due to the malfunction of an overflow sluice in 2002. Incidents such as this highlight the need to consider the flood risk implications of the canal for development planned in the Borough. The Canal and River Trust also acknowledges that there are some minor leaks along the canal embankments within Pendle. These are monitored on a regular basis and a 24 hour emergency response team is available to put measures in place to stop a flooding incident should the need arise.

The Canal and River Trust state that when developing sites next to and below the canal, or in an area where a breach from the canal could flow through, we advise that this risk should be considered by the developer to ensure that works do not impact any existing canal retaining structures and to ensure that a route is left for water to pass through the development safely, with safe exit routes available for persons on site.

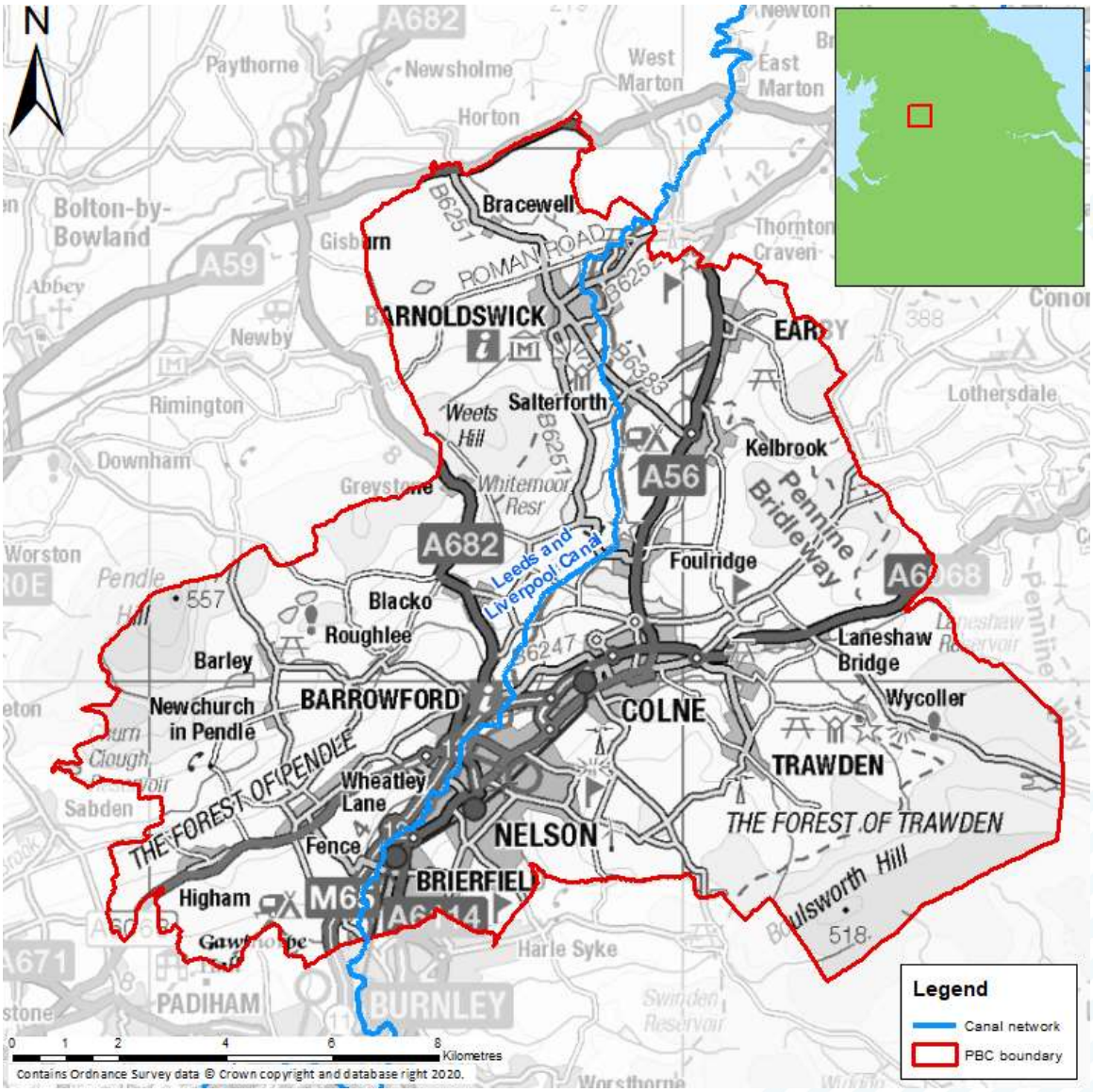

Figure 5-1: Canal network within PBC

5.5.2 Reservoirs

A reservoir can usually be described as an artificial lake where water is stored for use. Some reservoirs supply water for household and industrial use, others serve other purposes, for example, as fishing lakes or leisure facilities. Like canals, the risk of flooding associated with reservoirs is residual and is associated with failure of reservoir outfalls or breaching. This risk is reduced through regular maintenance by the operating authority. Reservoirs in the UK have an extremely good safety record with no incidents resulting in the loss of life since 1925.

The EA is the enforcement authority for the Reservoirs Act 1975 in England and Wales, with the Flood and Water Management Act (2010) amending this Act. All large reservoirs must be regularly inspected and supervised by reservoir panel engineers. LAs are responsible for coordinating emergency plans for reservoir flooding and ensuring communities are well prepared. The LPAs should work with other members of the Lancashire Resilience Forum to develop these plans. See Section 7.1.1 for more information on the Lancashire Resilience Forum.

Paragraph 014 of the FRCC-PPG states that, in relation to development planning and reservoir dam failure:

"the local planning authority will need to evaluate the potential damage to buildings or loss of life in the event of a dam failure, compared to other risks, when considering development downstream of a reservoir. Local planning authorities will also need to evaluate in Strategic Flood Risk Assessments (and when applying the Sequential Test) how an impounding reservoir will modify existing flood risk in the event of a flood in the catchment it is located within, and/or whether emergency draw-down of the reservoir will add to the extent of flooding."

The Canal & River Trust states that, where new development could lead to an increase in flood risk following a dam failure, the reservoir owner will require a contribution to the costs of improvement / remedial works and / or increased reservoir inspections to help maintain the risk exposure pre-development. Developer contributions in such circumstances should be confirmed early on in the site planning process.

5.5.3 Reservoir Flood Map (RFM)

The EA has produced Reservoir Flood Maps (RFM) for all large reservoirs that they regulated under the Reservoirs Act 1975 (reservoirs that hold over 25,000 cubic metres of water). The FWMA updated the Reservoirs Act and targeted a reduction in the capacity at which reservoirs should be regulated from 25,000m^3 to 10,000m^3. This reduction is, at the time of writing, yet to be confirmed meaning the requirements of the Reservoirs Act 1975 should still be adhered to.

In September 2016, the EA produced a RFM guide 'Explanatory Note on Reservoir Flood Maps for Local Resilience Forums – Version 5[9]' which provides information on how the maps were produced and what they contain.

The RFM can be viewed nationally at:

https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

The RFM shows that there are 15 reservoirs within the PBC boundary. The RFM extent shows the worst credible area that is susceptible to dam breach flooding. The map should be used to prioritise areas for evacuation/early warning. It is worth considering that reservoirs within the UK have an extremely good safety record with no incidents resulting in the loss of life since 1925.

If development is proposed downstream of a reservoir, there will need to be an assessment of whether work is needed to improve the design or maintenance of the reservoir. Together with the reservoir undertakers, the LPA should look to avoid an intensification of development within the risk areas and/or ensure that reservoir undertakers can assess the cost implications of any reservoir safety improvements required due to changes in land use downstream of these assets.

The LPA will need to evaluate:

- The potential damage to buildings or loss of life in the event of dam failure, compared to other risks;
- How an impounding reservoir will modify existing flood risk in the event of a flood in the catchment is located within, and/or whether emergency draw-down of the reservoir will add to the extent of flooding;
- Emergency planning requirements with appropriate officers to ensure safe, sustainable development.

[9] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/558441/LIT_6882.pdf

5.6 Historic flooding

On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate—

(a)which risk management authorities have relevant flood risk management functions, and

(b)whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

According to the LFRMS (2013), Lancashire, as a region, is divided in two by the M6 motorway, with the steeper upland catchments in the east, where flooding can occur rapidly and be more localised, and flatter lowland catchments in the west. In the areas to the west, the risk of flooding is predominantly linked to the capacity of the drainage networks, including piped networks in urban areas and open drainage ditches in both urban and rural areas. The areas to the east, flooding from local sources is predominantly as a result of intense rainfall events that cause surface water runoff and flooding from watercourses.

In addition to prolonged winter rainfall events which tend to cause extensive flooding in valley-bottom floodplains, heavy summer thunderstorms have also caused localised 'flash' flooding on a number of occasions including Barley to Barrowford (July 1881); Barnoldswick (July 1932, July 2009 and August 2014); Colne (September 2001 and August 2004), Trawden (August 2004) and Earby (August 2002, August 2004, August 2014 and September 2016). This type of flooding can be exacerbated by areas of steep topography in the catchments and settlements adjacent to the upper reaches of river systems with limited floodplains. Other notable events include December 2015, November 2017 and June 2018 which are detailed in Section 5.6.4.

The absence of a flood record in a location does not necessarily mean that there has been no recent or historical flooding at that location, only that an event may not have been recorded.

5.6.1 United Utilities (UU) supplied historic drainage events

UU provided shapefiles showing historic drainage incidents, both internal and external. These are shown below in Figure 5-2. The incidents are from 2011 to 2017; the incident data relates to incidents at property level which cannot be shown in detail on the Appendix B maps and thus are shown in smaller scale below.

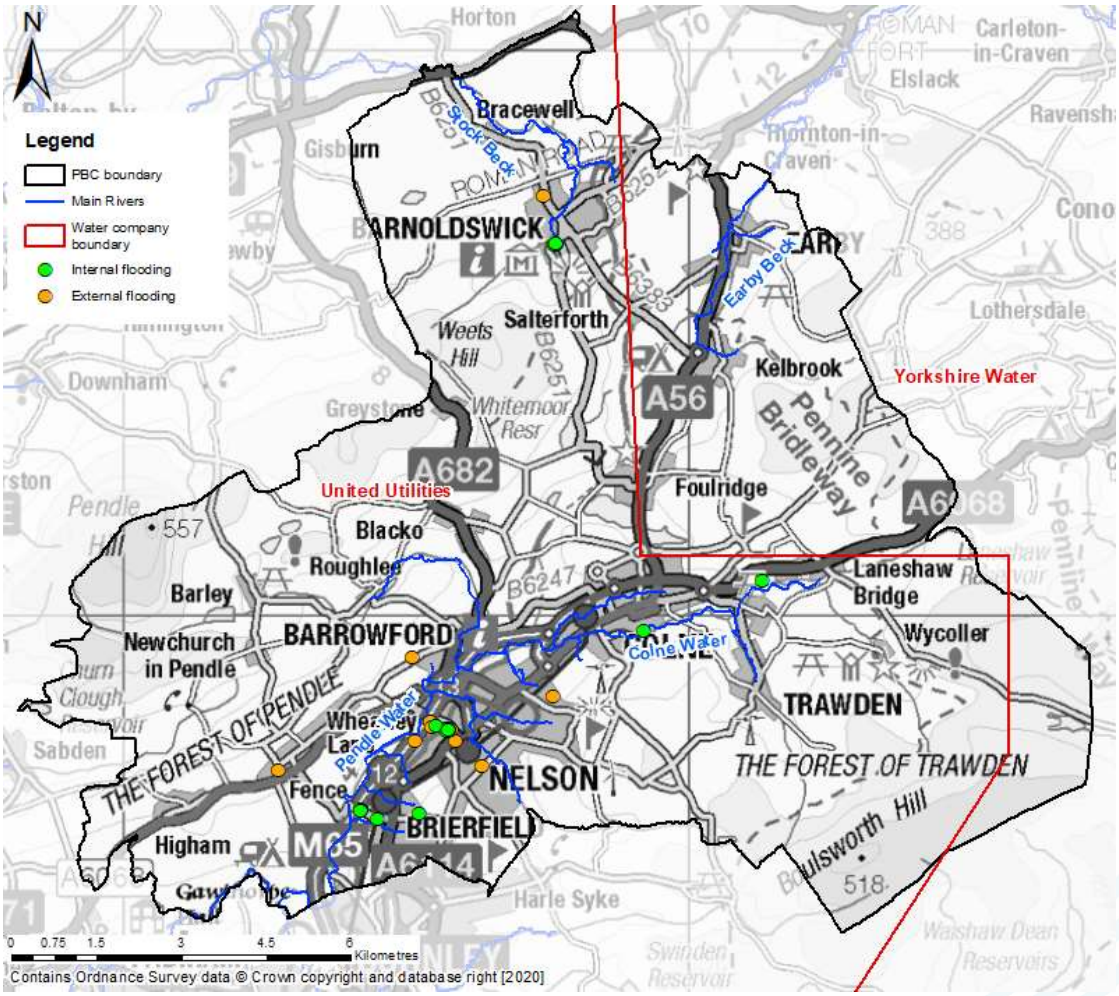

Figure 5-2: UU historical drainage incidents

5.6.2 Yorkshire Water (YWS) supplied historic drainage events

Yorkshire Water did not provide any GIS data regarding the historical drainage events. However, on the A56 (near Albion Road) and at the junction of Stoney Bank Road and Water Street in Earby, there have been problems with Yorkshire Water systems which have contributed to property flooding in those areas. PBC is working with them to try and find solutions.

5.6.3 Historic canal overtopping

According to the Canal and River Trust, three historic overtopping events have occurred within the Borough of Pendle; two events in 2013 and one further event in 2015. These events are shown spatially on Figure 5-3 below. Additionally, there was an overtopping event recorded into a field between locks 47 and 48 in early 2015. The event was relatively minor and localised.

There has also been one record of flooding associated with the canal in the borough. In 2002 the malfunction of an overflow sluice led to reports of flooding to a road and several properties in the village of Salterforth in the north of the Borough.

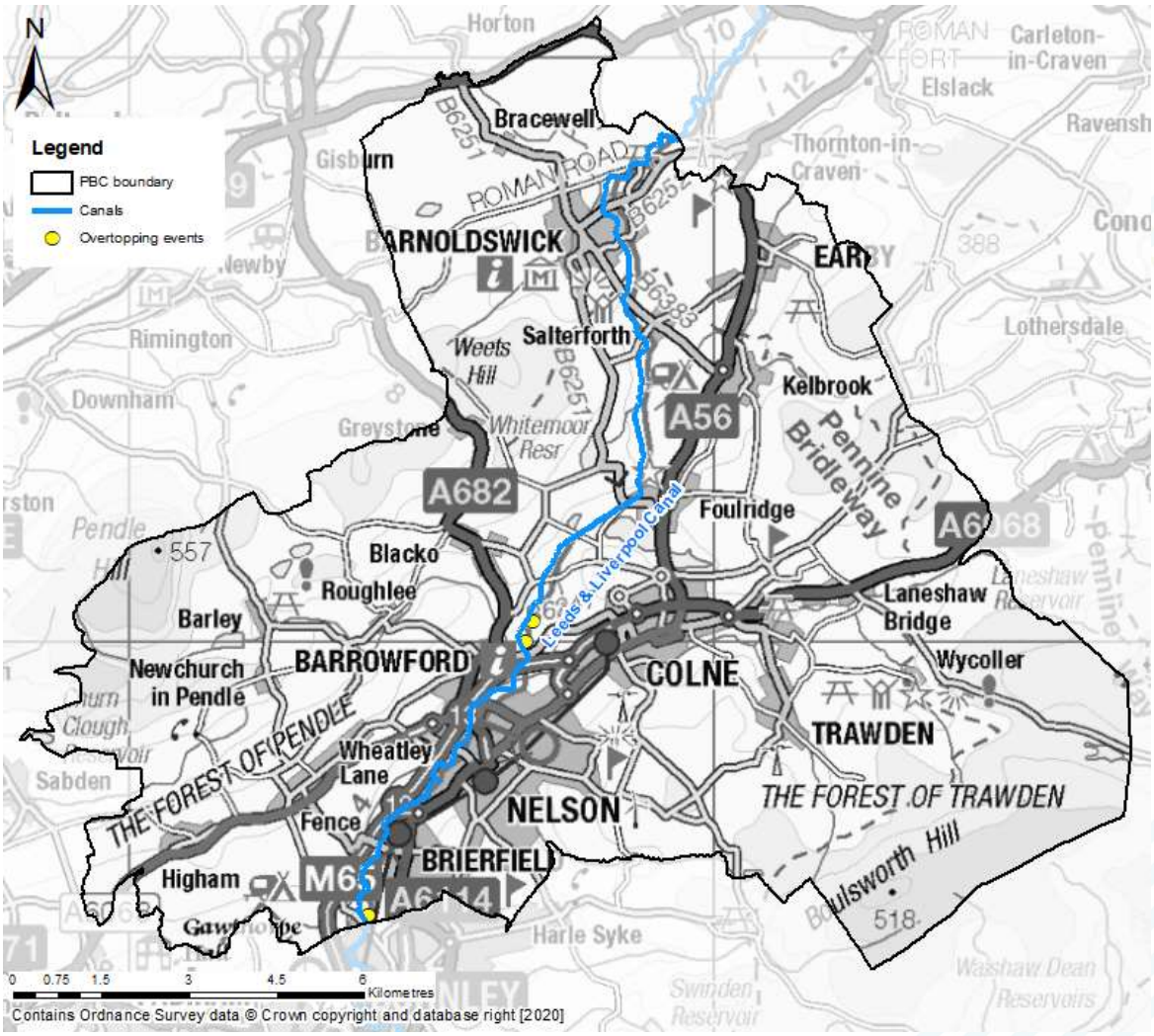

Figure 5-3: Historic canal overtopping events within PBC

5.6.4 Historic fluvial and surface water flood events

Summer 2012

Sewer flooding is often caused by excess surface water entering the drainage network. Two flood events occurred in the summer of 2012: one in June (surface water) and one in September (fluvial). In June, rain intensities were recorded at 10-15 mm per hour in several rain gauge regions. A total of 1,676 properties flooded across the North West due to overloaded sewers.

December 2015[10]

The extreme and unprecedented storms and rainfall events of November and December 2015 caused flooding throughout December to approximately 2,500 homes in Lancashire at 229 separate communities across the county. Exceptionally high river flows were recorded in the North West during November and December 2015; the largest ever flows recorded on an English River were recorded on the River Lune (approximately 1,700 cubic meters per second). Several major roads were flooded and not passable, bridges were closed due to structural concerns, and rail services were disrupted due to a landslide on the West Coast Main Line.

[10] https://www.lancashire.gov.uk/media/900010/section-19-flood-investigation-report-december-2015-floods.pdf

November 2017[11]

On the night of 22/23 November 2017, an intense rain storm was recorded travelling from the Irish Sea coast at Blackpool to the north-easterly extent of Lancaster District. The rainfall event overwhelmed natural and constructed drainage networks causing extensive surface water and river flooding. It dislodged soil/silt and vegetation which blocked drainage networks. Over 900 homes and other premises in Lancashire were flooded, either within property boundaries or inside habitable rooms.

However, within Pendle, only two streets were affected by the event; one street in Barrowford and one street in Nelson.

June 2018[12]

The evening of 1st June 2018 brought a series of very localised, high intensity downpours to parts of Lancashire. Towns and villages were particularly badly affected, with rain falling faster than it could be collected and dispersed by local urban drainage networks. The areas of Barnoldswick, Earby and Sough were those affected during this event.

5.6.5 EA Historic Flood Map

The Historic Flood Map (HFM) is a spatial dataset, available from the EA, showing the maximum extent of all recorded historic flood outlines from river, sea and groundwater, and shows areas of land that have previously been flooded across England. Records began in 1946 when predecessor bodies to the EA started collecting information about flooding incidents. The HFM accounts for the presence of defences, structures, and other infrastructure where such existed at the time of flooding. It includes flood extents that may have been affected by overtopping, breaches or blockages. It is also possible that historic flood extents may have changed and that some areas would not flood at present i.e. if a flood defence has been built.

The HFM does not contain any information regarding the specific flood source, return period or date of flooding, nor does the absence of the HFM in an area mean that the area has never flooded, only that records of historic flooding do not exist. The Recorded Flood Outlines (RFO) dataset however does include details of flood events. The difference between the two datasets is that the HFM only contains flood outlines that are 'considered and accepted' by the EA following adequate verification using certain criteria. For those areas not within an HFM or RFO outline, this does not mean these areas have never flooded, only that the EA does not have records of flooding in the area.

The HFM shows small areas of flooding being centred along Pendle Water near urban areas of Barrowford and Wheatley Lane. There is also flooding associated with Earby Beck to the northeast of the district near Earby.

The HFM and RFO datasets are shown on the SFRA maps in Appendix B.

5.7 Flood risk management

The aim of this section of the SFRA is to identify existing Flood Risk Management (FRM) assets and previous / proposed FRM schemes. The location, condition and design standard of existing assets will have a significant impact on actual flood risk mechanisms. Whilst future schemes in high flood risk areas carry the possibility of reducing the probability of flood events and reducing the overall level of risk. Both

[11] https://www.lancashire.gov.uk/media/912248/covering-report-nov-2017-section-19.pdf
[12] https://www.lancashire.gov.uk/media/913006/section-19-flood-investigation-report-june-2018-flooding.pdf

existing assets and future schemes will have a further impact on the type, form and location of new development or regeneration.

5.7.1 EA inspected assets (Spatial Flood Defences)

The EA maintain a spatial dataset called the Spatial Flood Defences dataset. This national dataset contains such information as:

- Asset type (flood wall, embankment, high ground, demountable defence, bridge abutment);
- Flood source (fluvial, tidal, fluvial and tidal combined);
- Design Standard of Protection (SoP);
- Asset length;
- Asset age;
- Asset location; and
- Asset condition.

See Table 5-4 for condition assessment grades using the EA's Condition Assessment Manual[13] (CAM).

The design standard of protection (SoP) for a flood defence is a measure of how much protection a flood defence gives. If the SoP is 100, the defence protects against a flood with the probability of occurring once in 100 years.

Grade	Rating	Description
1	Very Good	Cosmetic defects that will have no impact on performance
2	Good	Minor defects that will not reduce the overall performance of the asset
3	Fair	Defects that could reduce the performance of the asset
4	Poor	Defects that would significantly reduce the performance of the asset. Further investigation needed.
5	Very Poor	Severe defects resulting in complete performance failure.

Table 5-4: EA flood defence condition assessment grades

Defence Location	Asset Type	Flood Source	Watercourse	Design Standard	Condition
Earby	7 Flood Walls 6 Bridge Abutments	Fluvial	Earby Beck	30 (8) Unknown (5)	3 (7) 4 (5) Unknown (1)
Barrowford	7 Flood Walls	Fluvial	Pendle Water / Colne Water	100 (7)	3 (7)

[13] Environment Agency. (2012). Visual Inspection Condition Grades. In: EA Condition Assessment Manual. Bristol: Environment Agency. p9.

Nelson	7 Flood Walls	Fluvial	Walverden Water	100 (5) Unknown (2)	2 (4) 3 (3)
M65 Corridor - west of Barrowford	2 Flood Gates 12 Flood Walls 6 Embankments	Fluvial	Pendle Water	5 (1) 75 (2) 100 (15) Unknown (2)	2 (4) 3 (16)
Number in brackets = number of assets					

Table 5-5: Major flood defences in the Pendle

In total, there are 47 flood defence assets within the Borough of Pendle, according to the EA's Spatial Flood Defence dataset. Table 5-5 highlights the main locations within the district that have significant FRM assets, the majority of which are located on Pendle Water, west of Barrowford. There are a number of flood defence assets within PBC that have an unknown design standard.

Of the 47 constructed fluvial flood defence assets within Pendle, 33 are floodwalls, 6 are flood embankments, 6 are bridge abutments, and 2 are flood gates. The floodwalls aim to prevent the flooding of residential and commercial properties and infrastructure. All of the defences have been assessed at condition grade 2 or 3 meaning the condition is rated as 'Good' or 'Fair' according to the CAM (as discussed in Table 5-4) meaning there could be defects that could reduce the performance of the asset or the defects are only minor and would not compromise performance.

For the areas of Colne, Trawden and Barnoldswick, the flood defences are generally small-scale e.g. trash screens rather than purpose-built structures.

Along the majority of the Main Rivers within the Borough of Pendle, there are areas of high ground, offering protection from fluvial flooding. The condition grade of the majority of these defences is stated as 2/3, which means 'Good/Fair', as per the EA's CAM meaning there could be defects that could reduce the performance of the asset or the defects are only minor and would not compromise performance.

As well as the ownership and maintenance of a network of formal defence structures, the EA carries out a number of other flood risk management activities that help to reduce the probability of flooding, whilst also addressing the consequences of flooding. These include:

- Maintaining and improving the existing flood defences, structures and watercourses.
- Enforcement and maintenance where riparian owners carry out work that may be detrimental to flood risk.
- Identifying and promoting new Flood Risk Management Schemes (FRMS) where appropriate.
- Working with local authorities to influence the location, layout and design of new and redeveloped property and ensuring that only appropriate development is permitted relative to the scale of flood risk.
- Operation of Floodline Warnings Direct and warning services for areas within designated Flood Warning Areas (FWA) or Flood Alert Areas (FAA). EA FWAs are shown on the SFRA Maps in Appendix B.
- Promoting awareness of flooding so that organisations, communities and individuals are aware of the risk and therefore sufficiently prepared in the event of flooding.

- Promoting resilience and resistance measures for existing properties that are currently at flood risk or may be in the future as a result of climate change.

EA Areas Benefitting from Defences (ABD)

Alongside the Spatial Flood Defences dataset discussed above, the EA also publishes a spatial dataset showing the areas that benefit from major flood defences. ABDs show those areas that would benefit from the presence of defences in a 1% AEP fluvial or 0.5% AEP tidal flood event. The ABDs present within PBC are included on the SFRA maps in Appendix B and are also listed in Table 5-6.

The EA only maps defended areas that offer protection against a 1% AEP fluvial or 0.5% AEP tidal event, as required by the NPPF. This does not mean that only these areas are defended, but that other areas where defences may be present will have a lower standard of protection. ABDs do not take account of the effects of climate change and over time, the extent of an ABD will likely change as climate change reduces the standard of protection of existing defences.

Areas Impacted	Unitary Ward	Sites Impacted	Area (ha)	NGR
Corner of Lower Clough Street and Pendle Street, Barrowford	Barrowford and Pendleside	-	0.11	SD8456738931
All area between Wilton Street, Pendle Water and Pendle Street, Barrowford	Barrowford and Pendleside	-	11.96	SD8567339011
Meander of Colne Water, near Spring Gardens Road, Colne		-	2.22	SD8880039614

Table 5-6 Table of ABDs within PBC boundary

5.7.2 LCC assets and future Flood Risk Management schemes

Lancashire County Council, as Highway Authority, own and maintain a number of assets throughout the area which includes culverts, bridge structures, gullies, weirs and trash screens. These assets may lie along watercourses within smaller urban areas where watercourses may have been culverted or diverted, or within rural areas. All these assets can have flood risk management functions as well as an effect on flood risk if they become blocked or fail. In most cases responsibility lies with the riparian owner / landowner and may also lie with multiple landowners.

Lancashire County Council (as the LLFA), under the provisions of the FWMA, has a duty to maintain a register of structures or features that have a significant effect on flood risk, including details of ownership and condition as a minimum. The Asset Register should include those features relevant to flood risk management function including feature type, description of principal materials, location, measurements (height, length, width, diameter) and condition grade.

5.7.3 Water company assets

The sewerage infrastructure within the Borough of Pendle is likely to be based on Victorian sewers from which there may be a risk of localised flooding associated with the existing drainage capacity and sewer system. United Utilities and Yorkshire

Water are responsible for the management of the adopted sewerage system for their areas. This includes surface water and foul sewerage. There may however be some private surface water sewers in the area as only those connected to the public sewer network that were transferred to the water companies under the Private Sewer Transfer in 2011 are likely to have been constructed since this transfer date. Surface water sewers discharging to watercourses were not part of this transfer and would therefore not be under the ownership of UU or YWS, unless adopted under a Section 104 adoption agreement.

Water company assets include Wastewater Treatment Works, Combined Sewer Overflows, pumping stations, detention tanks, sewer networks and manholes.

5.7.4 Natural Flood Management / Working with Natural Processes

Natural flood management (NFM) or Working with Natural Processes (WwNP) is a type of flood risk management used to protect, restore and re-naturalise the function of catchments and rivers to reduce flood and coastal erosion risk. NFM is a component of Sustainable Drainage Systems (SuDS). WwNP has the potential to provide environmentally sensitive approaches to minimising flood risk, to reduce flood risk in areas where hard flood defences are not feasible and to increase the lifespan of existing flood defences. NFM and WwNP are used interchangeably in the UK though the term WwNP will be used throughout this report. As part of the evidence base for a site-specific FRA, defining NFM in the SFRA and identifying it as an alternative to hard engineering solutions is important to assist developers undertaking FRAs and identify any appropriate mitigation measures.

A wide range of techniques can be used that aim to reduce flooding by working with natural features and processes in order to store or slow down flood waters before they can damage flood risk receptors (e.g. people, property, infrastructure, etc.). WwNP involves taking action to manage flood and coastal erosion risk (although coastal erosion is not applicable to PBC) by protecting, restoring and emulating the natural regulating functions of catchments, rivers, floodplains and coasts (not applicable).

The Environment Agency have worked on the Ribble Catchment Flood Management Plan (RCFMP), which sets out sustainable flood risk management plan for the coming 50-100 years[14]. LCC have been involved in this project and have actively engaged with key partners including: Craven District Council, Ribble Valley Borough Council, Pendle Borough Council, Natural England, RSPB and landowners, in the Ribble and Hodder catchments.

Both the European Commission and UK Government are actively encouraging the implementation of WwNP measures within catchments and coastal areas in order to assist in the delivery of the requirements of various EC Directives relating to broader environmental protection and national policies. It is fully expected that the sustained interest in WwNP implementation across the UK will continue in the post-Brexit era as a fundamental component of the flood risk management tool kit.

Evidence base for WwNP to reduce flood risk

There has been much research on WwNP, but to date it has never been synthesised into one location. This has meant that it has been hard for flood risk managers to access up-to-date information on WwNP measures and to understand their potential benefits. The EA has produced the WwNP evidence base which includes three interlinked projects:

- Evidence directory

[14]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/293727/Ribble_Catchment_Flood_Management_Plan.pdf

- Mapping the potential for WwNP
- Research gaps

The evidence base can be accessed via:

https://www.gov.uk/government/publications/working-with-natural-processes-to-reduce-flood-risk

The evidence base can be used by those planning projects which include WwNP measures to help understand:

- Their potential FCRM benefits and multiple benefits
- Any gaps in knowledge
- Where it has been done before and any lessons learnt
- Where in a catchment they might not be most effective

The evidence directory presents the evidence base, setting out the scientific evidence underpinning it. Its purpose is to help flood risk management practitioners and other responsible bodies access information which explains what is known and what is not about the effectiveness of the measures from a flood risk perspective. There is also a guidance document which sits alongside the evidence directory and the maps which explains how to use them to help make the case for implementing WwNP when developing business cases.

Mapping the potential for WwNP

JBA Trust has worked with Lancaster Environment Centre (LEC) to produce an interactive catalogue of nature-based flood risk management projects in the UK. This map includes a catalogue of projects where WwNP is being applied on the ground or being considered as an option to reduce flood risk. Additionally, the map includes a set of layers that indicates the potential areas where WwNP would be beneficial based on research by the EA, Defra and NRW. The interactive map is available using this link:

https://naturalprocesses.jbahosting.com/

JBA Consulting has also been working with the EA and LEC to update national maps of Potential for Working with Natural Processes. LEC has developed a new spatial model of slowly permeable soils to identify areas where shrub or tree-planting could increase hydrological losses and slow the flow based on British Geological Survey (BGS) 1:50k maps, who have also agreed to an open government license for the maps. The new national maps for England make use of different mapping datasets and highlight potential areas for tree-planting (for three different types of planting), runoff attenuation storage, gully blocking, and floodplain reconnection. The maps can be used to signpost areas of potential, and do not take into account issues such as land-ownership and drainage infrastructure, but they may well help start the conversation and give indicative estimates of, for example, additional distributed storage in upstream catchments.

These maps are intended to be used alongside the evidence directory to help practitioners think about the types of measure that may work in a catchment and the best places in which to locate them. There are limitations with the maps, however it is a useful tool to help start dialogue with key partners. The maps are provided as spatial data for use in GIS and also interactive GeoPDF format, supported by a user guide and a detailed technical guide.

The WwNP types are listed in Table 5-7.

WWNP Type	Open data licence details
Floodplain reconnection	• Risk of Flooding from Rivers and Seas (April 2017) • Data derived from the Detailed River Network, which is not displayed, rescinding the licence requirements for displaying the dataset (to be superseded by OS Water Network but not available for project in time). • Constraints data
Run-off attenuation features	• Data derived from Risk of Flooding from Surface Water (Depth 1 percent annual chance and Depth 3.3 percent annual chance) (October 2013). The original data is not displayed, due to licensing restrictions.[2] • Constraints data • Gully blocking potential (a subset of run-off attenuation features on steeper ground) • Data derived from OS Terrain 50 (2016) to classify each run-off attenuation feature based on median slope.
Tree planting (3 categories)	• Floodplain: Flood Zone 2 from Flood Map for Planning (April 2016) and new constraints layer • Riparian: 50m buffer OS water features from Section 2.2.3 with constraints layer • Wider catchment woodland: - Based on slowly permeable soils. - BGS Geology 50,000 Superficial and Bedrock layers (both V8, 2017). Used with new science to derive new 100m gridded open data. This new layer can be used to signpost areas of SLOWLY PERMEABLE SOILS and can be checked in more detail on the BGS portal. - To the north of the line of Anglian glaciation, the presence of till-diamicton has been shown to be a strong predictor of slowly permeable soils. - To the south of this line, particular bedrock geologies have shown a similarly strong spatial relationship to the presence of slowly permeable soils.

Table 5-7: WwNP measures and data[15]

The WwNP datasets are included on the SFRA Maps in Appendix B and should be used to highlight any sites or areas where the potential for WwNP should be investigated further as a means of flood mitigation:

- Floodplain Reconnection:
  - Floodplain Reconnection Potential – areas of low or very low probability based on the Risk of Flooding from Rivers and Sea dataset (see Section 0), which are in close proximity to a watercourse and that do not contain properties, are possible locations for floodplain reconnection. It may be that higher risk areas can be merged, depending on the local circumstances.

[15]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/677592/Working_with_natural_processes_mapping_technical_report.pdf

- Runoff Attenuation Features (Run-off attenuation features are based on the premise that areas of high flow accumulation in the RoFSW) maps are areas where the runoff hydrograph may be influenced by temporary storage if designed correctly):
  - Runoff Attenuation Features 1% AEP
  - Runoff Attenuation Features 3.3% AEP
- Tree Planting:
  - Floodplain Woodland Potential and Riparian Woodland Potential – woodland provides enhanced floodplain roughness that can dissipate the energy and momentum of a flood wave if planted to obstruct significant flow pathways. Riparian and floodplain tree planting are likely to be most effective if close to the watercourse in the floodplain, which is taken to be the 0.1% AEP flood extent (Flood Zone 2), and within a buffer of 50 metres of smaller watercourses where there is no flood mapping available. There is a constraints dataset that includes existing woodland.
  - Wider Catchment Woodland Potential – slowly permeable soils have a higher probability of generating 'infiltration-excess overland flow' and 'saturation overland flow'. These are best characterised by gleyed soils, so tree planting can open up the soil and lead to higher infiltration and reduction of overland flow production.

Limitations

The effectiveness of WwNP measures is site-specific and depends on many factors, including the location and scale at which they are used. It may not always be possible to guarantee that these measures alone will deliver a specified standard of defence. Consequently, flood risk management measures should be chosen from a number of options ranging from traditional forms of engineering through to more natural systems. The research gaps that need to be addressed to move WwNP into the mainstream are identified in the evidence directory.

WwNP in PBC

The EA are working with partners on a NFM scheme for the upper reaches of Trawden Brook in the Ribble catchment. An initial assessment of Trawden Brook was carried out in March 2015 and a scoping study was carried out in 2017.

5.7.5 EA flood risk management activities and Flood and Coastal Erosion Risk Management research and development

The FCERM Research and Development programme is run by the EA and Defra and aims to serve the needs of all flood and coastal operating authorities in England. The programme provides the key evidence, information, tools and techniques to:

- Inform the development of FCERM policy and strategy.
- Understand and assess coastal and flood risk and the processes by which these risks arise.
- Manage flood and coastal erosion assets in a sustainable way.
- Prepare for and manage flood events effectively.

In March 2020, funding was secured for the next 6 years of investment. At the time of writing, a new investment programme is being developed that will link to the ambitions of the FCERM strategy for England.

The EA regularly reviews the programme to take into account changes such as:

- serious flooding.
- local partnership funding contributions.
- new flood risk information.

We develop projects to reduce flooding and coastal erosion by working with:

- local authorities.
- internal drainage boards.
- local communities.

Follow the link below for the latest news:

https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2

The potential works in the borough, at the time of writing, associated with the FCERM Development Programme includes:

- Pendle Ordinary Watercourse Study to help reduce fluvial flood risk. Potential scheme at appraisal stage and due to begin construction 2020/21.
- Earby Flood Alleviation Scheme Phase 2 to help reduce fluvial flood risk. Scheme was split into 3 parts that are all at different stages of progression. Construction dates are unknown at the time of writing.

6 Development and flood risk

6.1 Introduction

This section of the SFRA provides a strategic assessment of the suitability, relative to flood risk, of the assessed sites to be considered through the Local Plan.

The information and guidance provided in this chapter (also supported by the SFRA Maps in Appendix B and the Development Site Assessment spreadsheet in Appendix C) can be used by the LPA to inform its Local Plan and provide the basis from which to apply the Sequential Approach in the development allocation and development management process.

There are several consequential development considerations which could come out of the site assessment sequential testing process. The LPA should refer to Appendix E and Appendix C, for details on the site assessments carried out for this SFRA.

The LPA must use Appendix C to record its decisions on how to take each site forward or whether to remove a site from allocation, based on the evidence and strategic recommendations provided in this Level 1 SFRA. Recording decisions in the Sites Assessment Spreadsheet demonstrates that a sequential, sustainable approach to development and flood risk has been adopted.

6.2 The Sequential Approach

The FRCC-PPG provides the basis for the Sequential Approach. It is this approach, integrated into all stages of the development planning process, which provides the opportunities to reduce flood risk to people, property, infrastructure and the environment to acceptable levels.

The approach is based around the FRM hierarchy, in which actions to avoid, substitute, control and mitigate flood risk is central. For example, it is important to assess the level of risk to an appropriate scale during the decision-making process, (starting with this Level 1 SFRA). Once this evidence has been provided, positive planning decisions can be made and effective FRM opportunities identified.

Figure 6-1 illustrates the FRM hierarchy with an example of how these may translate into each authorities' management decisions and actions.

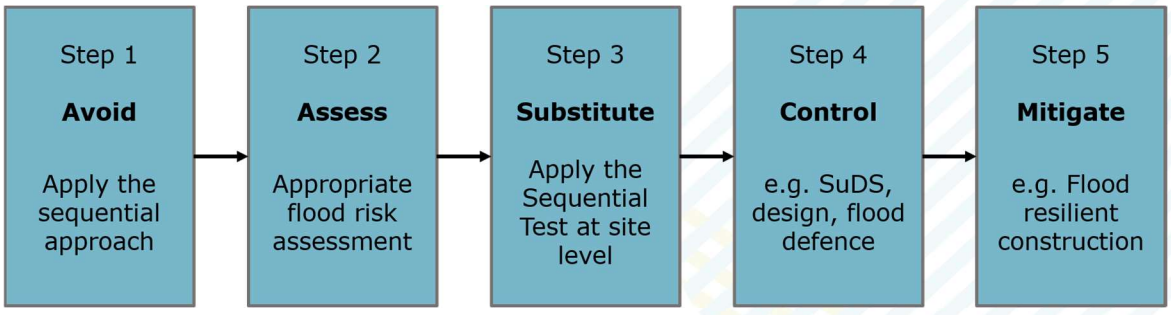

Figure 6-1: Flood risk management hierarchy

Using the EA's Flood Map for Planning, the overall aim of the Sequential Approach should be to steer new development to low risk Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, the flood risk vulnerability of land uses and reasonably available sites in Flood Zone 2 should be considered, applying the Exception Test if required.

Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in higher risk Flood Zone 3, be considered. This should take into

account the flood risk vulnerability of land uses and the likelihood of meeting the requirements of the Exception Test if required.

There are two different aims in carrying out the Sequential Approach depending on what stage of the planning system is being carried out i.e. LPAs allocating land in Local Plans or determining planning applications for development. This SFRA does not remove the need for a site-specific Flood Risk Assessment at a development management stage.

The following sections provide a guided discussion on why and how the Sequential Approach should be applied, including the specific requirements for undertaking Sequential and Exception Testing.

6.3 Local Plan Sequential and Exception tests

The Flood Risk and Coastal Change Planning Practice Guidance, para 019, states the aim of the Sequential Test is:

"…to steer new development to areas with the lowest probability of flooding. The flood zones as refined in the Strategic Flood Risk Assessment for the area provide the basis for applying the Test. The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of river or sea flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required."

The National Planning Policy Framework, paras 160-161, sets out the Exception Test as below:

"The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. For the exception test to be passed it should be demonstrated that:

a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

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

Both elements of the exception test should be satisfied for development to be allocated or permitted."

The LPA should seek to avoid inappropriate development in areas at risk of flooding by directing development away from areas at highest risk and ensuring that all development does not increase risk and where possible can help reduce risk from flooding to existing communities and development.

At a strategic level, this should be carried out as part of the LPA's Local Plan. This should be done broadly by:

1. Applying the Sequential Test and if the Sequential Test is passed, applying and passing the Exception Test, if required;
2. Safeguarding land from development that is required for current and future flood management (i.e. using potential for WwNP data);
3. Using opportunities offered by new development to reduce the causes and impacts of flooding;
4. Identifying where flood risk is expected to increase with climate change so that existing development may not be sustainable in the long term; and
5. Seeking opportunities to facilitate the relocation of development including housing to more sustainable locations.

Error! Reference source not found. illustrates the Sequential and Exception Tests as a process flow diagram using the information contained in this SFRA to assess sites put forward in the Local Plan against the EA's Flood Map for Planning flood zones and development vulnerability classification.

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

This can be done using the Development Site Assessment spreadsheets in Appendix C. This spreadsheet will help show that the LPA, through the SFRA, has applied the Sequential Test for sites at fluvial risk and also considered surface water flood risk in equal standing and thus considered development consideration options for each assessed site.

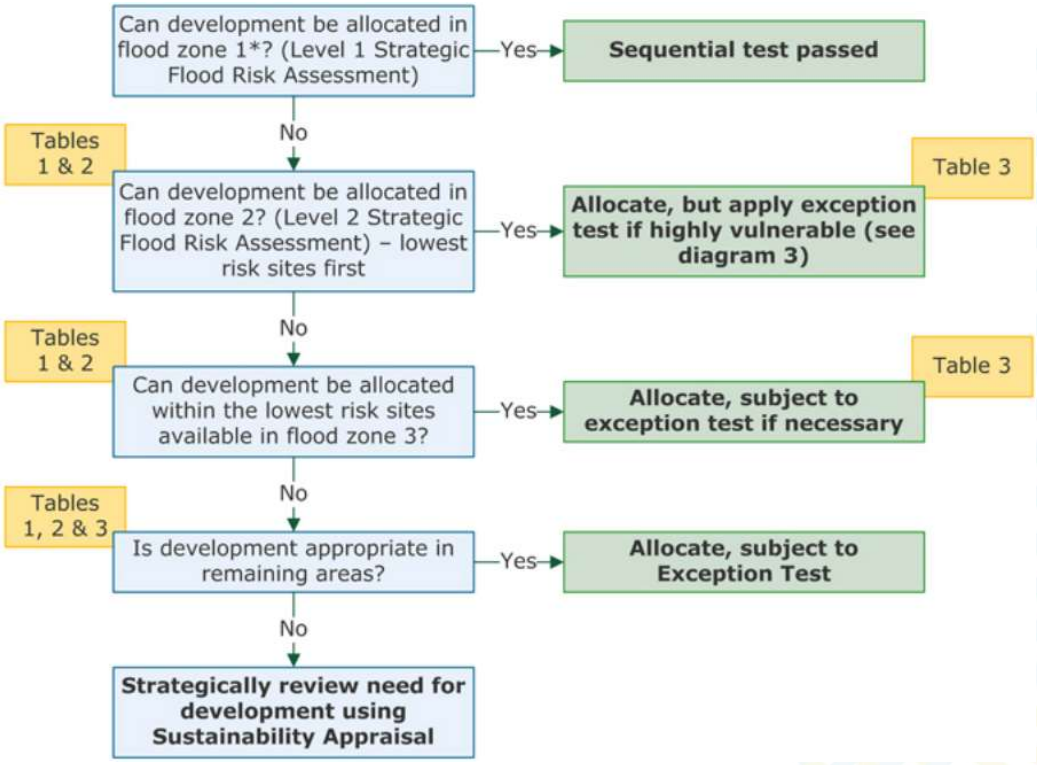

Figure 6-2: Local Plan sequential approach to site allocation[16]

[16] https://www.gov.uk/guidance/flood-risk-and-coastal-change#Sequential-Test-to-Local-Plan

**Other sources of flooding also need to be considered. For example, if the site is solely within FZ1 but is at risk from other sources and / or climate change impacts, the Sequential Test has not been satisfied.*

(Tables 1, 2, 3 refer to the Flood Zone and flood risk tables of the FRCC-PPG Paragraphs 065-067).

The approach provides an open demonstration of the Sequential Test being applied in line with the NPPF and the FRCC-PPG. The LPA should agree a locally specific approach to application of the Sequential Test, based on the available evidence and circumstances. The EA would not approve the locally specific approach taken by the LPA, however the LPA can consult the EA regarding proposed sites and any local information or consultations with the LLFA should also be taken into account.

This SFRA provides the main evidence required to carry out this process. The process also enables those sites that have passed the Sequential Test, and may require the Exception Test, to be identified. Following application of the Sequential Test the LPA and developers should refer to 'Table 3: Flood risk vulnerability and flood zone 'compatibility'' of the FRCC-PPG (Paragraph 067) when deciding whether a development may be suitable or not.

Although passing the Exception Test will require the completion of a site-specific FRA, the LPAs should be able to assess the **likelihood** of passing the test at the Local Plan level by using the information contained in this SFRA to answer the following questions:

a. Can development within higher risk areas be avoided or substituted?
b. Is flood risk associated with possible development sites considered too high; and will this mean that the criteria for Exception Testing are unachievable?
c. Can risk be sustainably managed through appropriate development techniques (resilience and resistance) and incorporate Sustainable Drainage Systems without compromising the viability of the development?
d. Can the site, and any residual risks to the site, be safely managed to ensure that its occupiers remain safe during times of flood if developed?

Where it is found to be unlikely that the Exception Test can be passed due to few wider sustainability benefits, the risk of flooding being too great, or the viability of the site being compromised by the level of flood risk management work required, then the LPA should consider avoiding the site altogether.

Once this process has been completed, the LPA should then be able to allocate appropriate development sites through its Local Plan as well as prepare flood risk policy including the requirement to prepare site-specific FRAs for all allocated sites that remain at risk of flooding or that are greater than one hectare in area.

6.4 Sustainability Appraisal (SA) and flood risk

The Sustainability Appraisal (Section A.5.4 of Appendix A) of the Local Plan should help to ensure that flood risk is taken into account at all stages of the planning process with a view to directing development away from areas at flood risk, now and in the future, by following the sequential approach to site allocation, as shown in **Error! Reference source not found.**. The SA should be informed by this SFRA so that flood risk is fully taken into account when considering allocation options and in the preparation of plan policies, including policies for flood risk management to ensure that flood risk is not increased (para 010 FRCC-PPG).

By avoiding sites identified in this SFRA as being at significant risk, such as those listed in Section E.1.1 of Appendix E or by considering how changes in site layout can avoid those parts of a site at flood risk, such as any site included within

Recommendation C (Section E.1.3 of Appendix E), the Council would be demonstrating a sustainable approach to development.

In terms of surface water, the same approach should be followed whereby those sites at highest risk should be avoided or site layout should be tailored to ensure sustainable development. This should involve investigation into appropriate SuDS techniques (see Section 6.7).

Surface water flood risk should be considered with the same importance as fluvial flood risk.

Once the LPA has decided on a final list of sites following application of the Sequential Test and, where required, the Exception Test following a Level 2 SFRA, a phased approach to development should be carried out to avoid any cumulative impacts that multiple developments may have on flood risk. For example, for any site where it is required, following the Sequential Test, to develop in Flood Zone 3, detailed modelling would be required to ascertain where displaced water, due to development, may flow and to calculate subsequent increases in downstream flood volumes. The modelling should investigate scenarios based on compensatory storage techniques to ensure that downstream or nearby sites are not adversely affected by development on other sites.

6.4.1 Cumulative impacts

The NPPF (2021) states that strategic policies…

"…should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards". (para 160)

Previous policies have relied on the assumption that if each individual development does not increase the risk of flooding, the cumulative impact will also be minimal. However, if there is a lot of development occurring within one catchment, particularly where there is flood risk to existing properties or where there are few opportunities for mitigation or proposed developments of less than 10 dwellings that are not referred to the LLFA for consultation under the DMPO 2015, the cumulative impact may be to change the flood response of the catchment.

Consideration should be given to the following:

- The importance of phasing of development, as discussed in Section 6.4.4;
- Cross boundary impacts i.e. there should be dialogue between PBC and neighbouring authorities upstream and downstream of Pendle, primarily those also located within LCC's authority area. Decisions on flood risk management practices and development in these authorities should involve discussion with PBC given the possible downstream impacts of development on flood risk (see Section 6.4.2);
- Leaving space for floodwater, utilising greenspace for flood storage and slowing the flow (see Sections 6.4.3 and 5.7.4), with its potential links to biodiversity net gain and enhancing the natural environment for biodiversity;
- Must ensure flood plain connectivity; and
- SuDS and containment of surface water onsite as opposed to directing elsewhere (Section 6.7).

When allocating land for development, consideration should be given to the potential cumulative impact of the loss of floodplain storage volume, as well as the impact of increased flows on flood risk downstream. Whilst the loss of storage for individual

developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe.

All developments are required to comply with the NPPF and demonstrate they will not increase flood risk elsewhere. Therefore, providing all new development complies with the latest guidance and legislation relating to flood risk and sustainable drainage, in theory there should not be any increase in flood risk downstream.

Strategic solutions may include upstream flood storage, integrated major infrastructure/ Flood Risk Management schemes, new defences, and watercourse improvements as part of regeneration and enhancing green infrastructure, with opportunities for Working with Natural Processes and retrofitting of SuDS to existing development.

Through the Local Plan, the LPA should consider the following strategic solutions:

- Use of sustainable flood storage and mitigation schemes to store water and manage surface water runoff in locations that provide overall flood risk reduction as well as environmental benefits (see Section 6.7.2),
- In areas where flood risk is being managed effectively, there will be a need in the future to keep pace with increasing flood risk as a result of climate change,
- Assessment of long-term opportunities to move development away from the floodplain and to create blue/green river corridors throughout PBC,
- Identification of opportunities to use areas of floodplain to store water during high flows, to reduce long-term dependence on engineered flood defences located both within and outside PBC,
- Safeguarding the natural floodplain from inappropriate development,
- Where possible, changes in land management should look to reduce runoff rates from development whilst maintaining or enhancing the capacity of the natural floodplain to retain water. Land management and uses that reduce runoff rates in upland areas should be supported,
- Development should maintain conveyance of watercourses through hamlets and villages to help reduce the impact of more frequent flood events and to improve the natural environment and WFD targets,
- Use of this SFRA to inform future development and minimise flood risk from all sources,
- Implementation of upstream catchment management i.e. slow the flow and flood storage schemes could be implemented in upper catchments to reduce risk downstream and across neighbouring authority boundaries, and
- Promotion and consideration of SuDS at the earliest stage of development planning.

According to the NPPF, the LPA should work with neighbouring authorities to consider strategic cross boundary issues and infrastructure requirements. Local authorities also have a duty to cooperate whereby councils work together on strategic matters and produce effective and deliverable policies on strategic cross boundary matters.

The Flood and Water Management Act 2010 requires all risk management authorities (RMAs) to cooperate with relevant authorities regarding exercising flood and coastal risk management. Lancashire, Blackburn-with-Darwen and Blackpool are represented on the North West Regional Flood and Coastal Committee where cross-boundary resources, projects and data are shared with Merseyside, Cheshire, Cumbria and Greater Manchester.

6.4.2 Hydrological linkages and cross boundary issues

Figure 6-3 illustrates fluvial hydraulic linkages for the catchments in and around the Borough of Pendle. The Main Rivers of Colne Water and Pendle Water, Earby Beck and Stock Beck originate within Pendle and flow directly into the districts of Craven, Ribble Valley and Burnley. It is important that the strategic solutions stated above are fully considered in development planning in these catchments, to ensure there are no adverse effects on flood risk in the downstream authorities of Craven, Ribble Valley and Burnley. Pendle does not receive from any district.

Were these strategic solutions not considered in upstream development planning, the following issues may occur:

- Reduction in upstream floodplain storage capacity; and
- Increase in impermeable areas leading to a reduction in rainfall infiltration and subsequent increased runoff.

These issues highlight the importance of the LFRP and the need to work together on flood risk management, particularly where actions could exacerbate flooding in downstream communities. The need for consistent regional development policies controlling runoff or development in floodplains within contributing districts is therefore crucial as this would have wider benefits for Lancashire authorities as a whole as well as Pendle. This should be carried out by the successful implementation of the Sequential Test. Appropriate flood risk management policies will be required in the Local Plan.

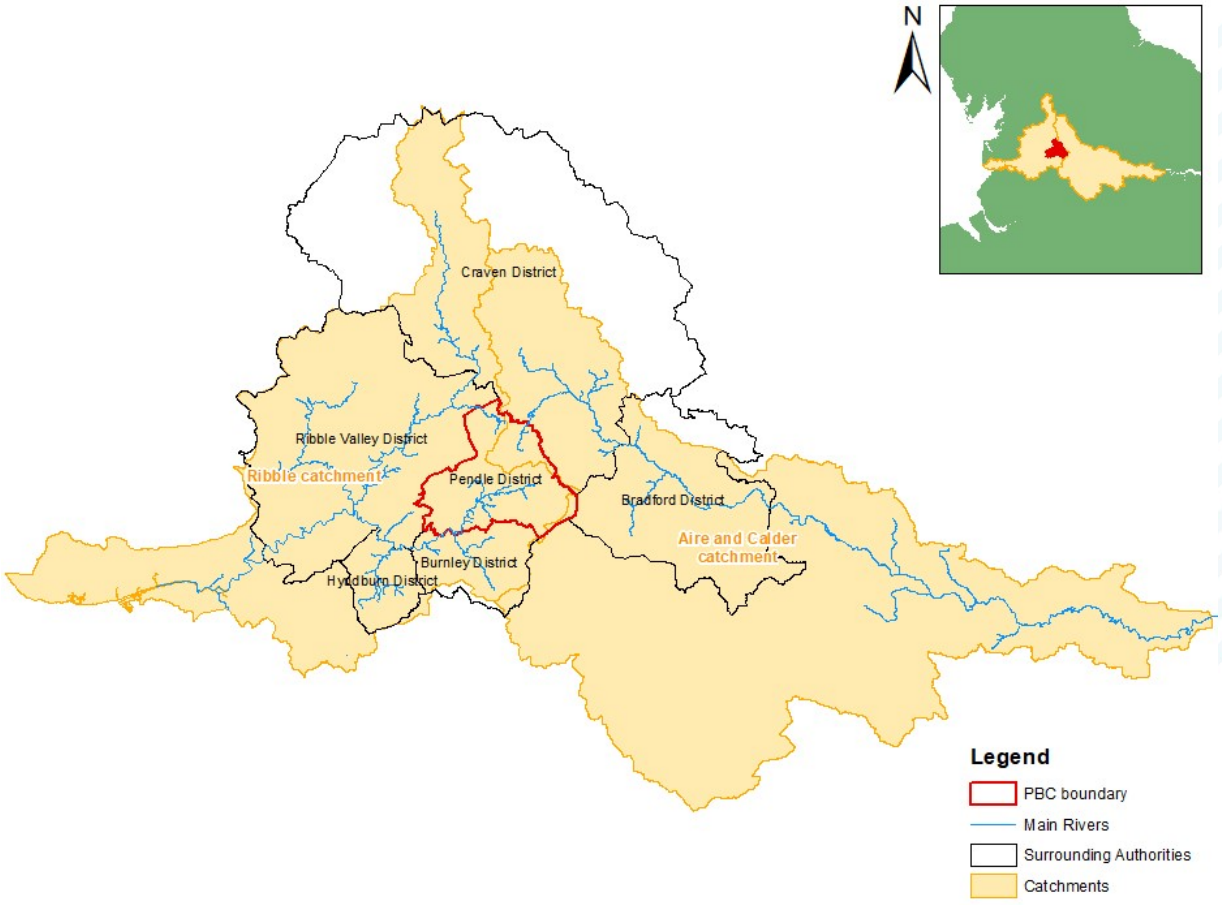

Figure 6-3: Fluvial hydraulic linkages for catchments in and around the Borough of Pendle

6.4.3 Safeguarding land for flood storage

Where possible, the LPA may look to allocate land for flood storage functions. Such land can be explored through the site allocation process whereby an assessment is made, of the flood risk at assessed sites and what benefit could be gained by leaving the site undeveloped. In some instances, the storage of flood water can help to alleviate flooding elsewhere, such as downstream developments. Where there is a large area of a site at risk that is considered large enough to hinder development, it may be appropriate to safeguard this land for the storage of flood water.

Section 14 Paragraph 161 of the NPPF states that, to avoid where possible, flood risk to people and property they should manage any residual risk by

'safeguarding land from development that is required, or likely to be required, for current or future flood management'

Applicable sites assessed through this SFRA may include any current greenfield sites:

- That are considered to be large enough (>1 hectare) to store flood water to achieve effective mitigation,
- With large areas of their footprint at high or medium surface water flood risk (based on the RoFSW),
- That is within the functional floodplain (Flood Zone 3b),
- With large areas of their footprint at risk from Flood Zone 3a, and
- That are large enough and within a suitable distance to receive flood water from a nearby development site using appropriate SuDS techniques which may involve pumping, piping or swales / drains. Note: pumping is considered a last resort due to ongoing maintenance needs.

Brownfield sites could also be considered though this would entail site clearance of existing buildings, conversion to greenspace and contaminated land assessments.

By using the sequential approach to site layout, the LPA and developers should be able to avoid the areas at risk and leave clear for potential flood storage. See the SFRA Maps in Appendix B to spatially assess the areas of the sites at risk.

6.4.4 Phasing of development

Flood risk should be taken into account at all stages of the planning process with a view to directing development away from areas at flood risk, now and in the future, by following the sequential approach to site allocation, as shown in **Error! Reference source not found.**.

Using a phased approach to development, based on modelling results of floodwater storage options, should ensure that any sites at risk of causing flooding to other sites are developed first in order to ensure flood storage measures are in place before other sites are developed, thus ensuring a sustainable approach to site development. Also, it may be possible that flood mitigation measures put in place at sites upstream could alleviate flooding at downstream or nearby sites. Large strategic multiple development sites should also carry out development phasing within the overall site boundary so as to avoid cumulative impacts within the site, as well as off the site (see Section 5.7.4 for information on Natural Flood Management and Working with Natural Processes). They will also need to consider how surface water will be managed on-site during each construction phase to ensure flooding does not occur to adjacent land during construction.

The EA states that the optimum approach would be to have all development sites that make up a large strategic site to have all developers sign up to a Flood Risk and Drainage Masterplan from the very start of the planning stage. It is often the case that outline planning permission is given for larger strategic sites with individual

developers then submitting further separate site-specific FRAs that are not joined up with the rest of the overall site. These individual FRAs can then often be devoid of all the green SuDS infrastructure touted within the Outline FRA.

6.5 Guidance for developers

This SFRA provides the evidence base for developers to assess flood risk at a strategic level and to determine the requirements of an appropriate site-specific FRA. Before carrying out an FRA, developers should check with the LPA whether the Sequential Test has been carried out. If not, the developer must apply the Sequential Test as part of their FRA by comparing their indicative development site with other available sites to ascertain which site has the lowest flood risk. The EA provides advice on this via:

https://www.gov.uk/guidance/flood-risk-assessment-the-sequential-test-for-applicants

Table 6-1 identifies, for developers, when the Sequential and Exception Tests are required for certain types of development and who is responsible for providing the evidence and those who should apply the test if required.

Development	Sequential Test Required?	Who Applies the Sequential Test?	Exception Test Required?	Who Applies the Exception Test?
Allocated Sites	No (assuming the development type is the same as that submitted via the allocations process)	LPA should have already carried out the test during the allocation of development sites	Dependent on land use vulnerability	LPA to advise on the likelihood of test being passed. The developer must also provide evidence that the test can be passed by providing planning justification and producing a detailed FRA
Windfall Sites	Yes	Developer provides evidence, to the LPA that the test can be passed. An area of search will be defined by local circumstances relating to the catchment and for the type of development being proposed	Dependent on land use vulnerability	Developer must provide evidence that the test can be passed by providing planning justification and producing a detailed FRA
Regeneration Sites Identified Within Local Plan	No	-	Dependent on land use vulnerability	LPA to advise on the likelihood of test being passed. The developer must also provide evidence that the test can be passed by providing planning

Development	Sequential Test Required?	Who Applies the Sequential Test?	Exception Test Required?	Who Applies the Exception Test?
				justification and producing a detailed FRA
Redevelopment of Existing Single Properties	No	-	Dependent on land use vulnerability	Developer must provide evidence that the test can be passed by providing planning justification and producing a detailed FRA
Changes of Use	No (except for any proposal involving changes of use to land involving a caravan, camping or chalet site)	Developer provides evidence to the LPA that the test can be passed	Dependent on land use vulnerability	Developer must provide evidence that the test can be passed by providing planning justification and producing a detailed FRA

Table 6-1: Development types and application of Sequential and Exception Tests for developers

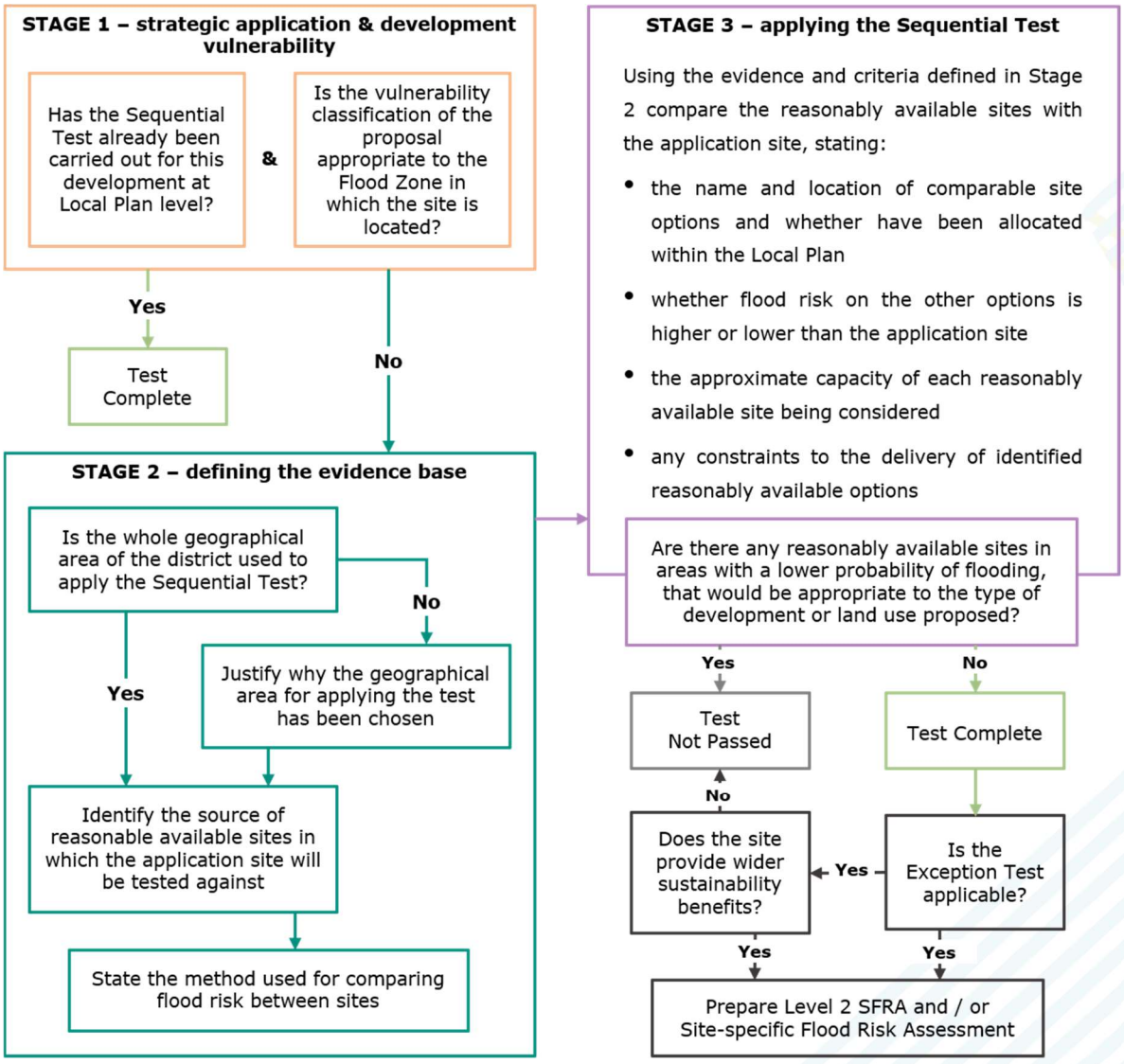

Figure 6-4: Development management Sequential Test process

Figure 6-4 shows what developers should do with regards to applying the Sequential Test if the LPA has not already done so.

The Sequential Test does not apply to change of use applications unless it is for change of land use to a caravan, camping or chalet site, or to a mobile home site or park home site. The Sequential Test can also be considered adequately demonstrated if both of the following criteria are met:

- The Sequential Test has already been carried out for the site (for the same development type) at the strategic level (Local Plan); and
- The development vulnerability is appropriate to the Flood Zone (see Table 3 of the FRCC-PPG).

If both these criteria are met, reference should be provided for the site allocation of the Local Plan document and the vulnerability of the development should be clearly stated.

When applying the Sequential Test, the following should also be considered:

- **The geographic area in which the Test is to be applied;**

- **The source of reasonable available sites in which the application site will be tested against; and**
- **The evidence and method used to compare flood risk between sites.**

Sites could be compared in relation to flood risk, Local Plan status; capacity; and constraints to delivery including availability, policy restrictions, physical problems or limitations, potential impacts of the development on the local area, and future environmental conditions that would be experienced by the inhabitants of the development.

The test should conclude if there are any reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use that has been put forward in the Local Plan.

The LPA should now have sufficient information to be able to assess whether or not the indicative site has passed the Sequential Test. If the Test has been passed, then the developer should apply the Exception Test in the circumstances set out by tables 1 and 3 of the FRCC-PPG.

In all circumstances, where the site is within areas at risk of flooding and where a site-specific FRA has not already been carried out, a site-specific should be completed in line with the NPPF and the FRCC-PPG.

In addition to the formal Sequential Test, the NPPF sets out the requirement for developers to apply the sequential approach to locating development within the site. As part of their application and masterplanning discussions with applicants, LPAs should seek whether or not:

- Flood risk can be avoided by substituting less vulnerable uses or by amending the site layout;
- Less vulnerable uses for the site have been considered; or
- Density can be varied to reduce the number or vulnerability of units located in higher risk parts of the site.

When initially considering the development options for a site, developers should use this SFRA, the NPPF and the FRCC-PPG to:

- ***Identify whether the site is***
    - *A windfall development, allocated development, within a regeneration area, single property or subject to a change of use to identify if the Sequential and Exception Tests are required.*
- ***Check whether the Sequential Test and / or the Exception Test have already been applied***
    - *Request information from the LPA on whether the Sequential Test, or the likelihood of the site passing the Exception Test, have been assessed;*
    - *If not, provide evidence to the LPA that the site passes the Sequential Test and will pass the Exception Test.*
- ***Consult with the LPA, the LLFA and the EA and the wider group of flood risk consultees, where appropriate, to scope an appropriate FRA if required***
    - *Guidance on FRAs is provided in Appendix E.3.4 of this SFRA;*
    - *Also, refer to the EA Standing Advice, the NPPF and the FRCC-PPG;*
    - *Consult the LLFA*
- ***Submit FRA to the LPA for approval. The LPA may then consult the EA, if required. The EA will then review the FRA in relation to their remit and give recommendations to the LPA.***

6.6 Planning for climate change (NPPF, 2021)

In relation to flood risk and climate change in the planning system, the NPPF (2021) states:

"All plans should apply a sequential, risk-based approach to the location of development – taking into account the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property." (para 161).

Local plans should do this by safeguarding land from development that is required, or likely to be required, for current or future flood management; and to seek opportunities for the relocation of development, including housing, to more sustainable locations from areas where climate change is expected to increase flood risk.

6.6.1 EA climate change allowances

The EA revised the climate change allowances in 2021, for use in FRAs and SFRAs and will use these revised allowances when providing advice. There have been

several updates carried out to the allowances since the release of UKCP18. The most up-to-date allowances are available online via:

https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Developers should refer to the climate change allowances on the Government website to ensure those outlined below are the most up-to-date available.

The climate change allowances are predictions of anticipated change for:

- Peak river flow by River Basin District (see Table 6-2 for Aire and Calder, and Ribble management catchment allowances);
- Peak rainfall intensity;
- Sea level rise by River Basin District (see Table 6-4 for North West and Humber RBD sea level allowances); and
- Offshore wind speed and extreme wave height.

RBD	Allowance Category	Total Potential Change Anticipated for...		
		2020s (2015-2039)	2050s (2040-2069)	2080s (2070-2115)
Aire and Calder	Upper end	+24%	+31%	+51%
	Higher central	+15%	+18%	+31%
	Central	+11%	+13%	+23%
Ribble	Upper end	+27%	+44%	+71%
	Higher central	+19%	+29%	+46%
	Central	+16%	+23%	+36%

Table 6-2: Recommended peak river flow allowances for the Aire and Calder, and Ribble management catchments

The peak rainfall intensity allowances apply to the whole of England for small catchments (less than 5 km^2) and urban catchments, though for the North West or Humber RBDs for large rural catchments. SFRAs and FRAs should assess both the central and upper end allowances to gauge the range of impacts.

Allowance Category	Total Potential Change Anticipated for...		
	2015-2039	2040-2069	2070-2115
Upper end	+10%	+20%	+40%
Central	+5%	+10%	+20%

Table 6-3: Peak rainfall intensity allowances in small and urban catchments for England

Sea level allowances are based on different regions of England. The allowances for the North West of England are shown below in Table 6-4. The number in brackets is the cumulative sea level rise for each year within each range.

	2000 - 2035	2036 - 2065	2066 - 2095	2096 - 2125	Cumulative rise 2000 – 2125 (m)
Upper end	5.7 (200)	9.9 (297)	14.2 (426)	16.3 (489)	1.41
Central	4.5 (158)	7.3 (219)	10 (300)	11.2 (336)	1.01

Table 6-4: Sea level allowance for North West England

The EA will also require consideration, if appropriate, of the 'high++ allowances' for peak river flows and mean sea level rise (although sea level rise does not apply to PBC) where a development is considered to be very sensitive to flood risk and with lifetimes beyond the end of the century. This could include infrastructure projects or developments that significantly change existing settlement patterns. The high++ allowances can be found in the EA's *Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities*[17], which uses science from UKCP09. This guidance is based on the Government's policy for climate change adaptation and is specifically intended for projects or strategies seeking Government FDGiA funding. However, RMAs in England may also find it useful in developing plans and making FCERM investment decisions even if there is no intention of applying for central government funding. This is important for any future large-scale infrastructure used to support the delivery of strategic sites such as flood defence schemes.

Although, it is anticipated that increases in river flows will lie somewhere within the range of the central to upper end estimates of the February 2016 allowances, more extreme change cannot be discounted. The high++ allowances can be used to represent more severe climate change impacts and help to identify the options that would be required.

PBC can, if they wish, specify what % of climate change allowance should be applied to development in Pendle, or they can stick with national guidance.

The LLFA would support the application of upper end allowances on all major development. Also helps to streamline development.

UKCP18

In November 2018 Defra released a new set of UK Climate Projections (UKCP18). These projections replace the UKCP09 projections which have been used for the past ten years. In February 2019, the EA stated that the 2016 guidance is being revised in line with the UK Climate Projections 2018. An update was provided in December 2019 whereby the EA stated the following updates to the guidance:

1. Updated the sea level rise allowances using UKCP18 projections.
2. Added guidance on how to
    a. calculate flood storage compensation,
    b. use peak rainfall allowances to help design drainage systems,
    c. account for the impact of climate change on storm surge,
    d. assess and design access and escape routes for less vulnerable development.
3. Changed the guidance on how to apply peak river flow allowances so the approach is the same for both flood zones 2 and 3.

[17] Environment Agency Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities

In July 2021, there was a further update in which the peak river allowances were updated with the UKCP18 projections to be based on management catchments rather than river basin districts. There were also changes to guidance on how to apply peak river flow allowances. You now use:

a) the central allowance for all assessments except for essential infrastructure, where you use the higher central allowance

b) the upper end for 'credible maximum scenario' assessments, and

c) the central allowance to calculate flood storage compensation, except for where essential infrastructure is affected, where you use the higher central allowance.

6.6.2 Climate change data in Pendle

The climate change allowances were updated July 2021 and are based on EA Management Catchments. The updated allowances for the Aire and Calder, and Ribble management catchments are shown below in Table 6-5.

Ribble	Existing	Proposed
Upper end	70%	75%
Higher central	35%	46%
Central	30%	36%

Aire and Calder	Existing	Proposed
Upper end	70%	51%
Higher central	35%	31%
Central	30%	23%

Table 6-5: Climate change allowances for Ribble and Aire and Calder management catchments

At the inception of this Level 1 SFRA, a request was made to the EA for the provision of modelled climate change flood outlines, based on the 2016 allowances, for all applicable fluvial hydraulic models in the Borough of Pendle area. This would enable an up to date assessment of the risk from climate change to the potential development sites, as required by the EA's 2020 updated SFRA guidance. Table 6-6 below shows the models that were provided with climate change outlines.

Model	Events
Earby Beck 2018	0.5% AEP +20%CC 1% AEP +20%CC, +30%CC, +50%CC
Hendon Brook 2018	1% AEP +30%CC, +35%CC, +70%CC
Burnley Nelson Colne 2020 includes MFOs for: Brun Calder, Colne Water, Edge End Brook, Hollins Mill, North Valley, Pendle Water, Primet Water, Swinden Clough, and Walverden Water	1% AEP +30%CC, +35%CC, +70%CC

Table 6-6: Models used in study with climate change

A precautionary and pragmatic approach has been adopted to assessing future flood risk in this SFRA, whereby the assumption is that all potential development sites identified to be at existing risk from fluvial flooding (those sites within Flood Zone 2, 3a or 3b), are at risk from the effects of climate change. We have also assumed that

any site wholly within Flood Zone 1 that is within 20 metres of Flood Zone 2 may be at long term fluvial risk. Appendix E.2 discusses this approach and the sites affected.

The effects of climate change on surface water risk has not been modelled nationally, therefore this SFRA has considered that any site at existing surface water risk, as defined by the EA's national Risk of Flooding from Surface Water map, will likely be at increased risk in the longer term.

The Sites Assessment Spreadsheet in Appendix C indicates the sites that may be at increased risk in the long term, based on the approaches outlines above. Appendix E.2 provides more detail on the approaches taken and discussion on the sites considered to be at long term risk.

6.7 Sustainable Drainage Systems (SuDS)

Development has the potential to cause an increase in impermeable area, an associated increase in surface water runoff rates and volumes, and consequently a potential increase in downstream flood risk due to overloading of sewers, watercourses, culverts and other drainage infrastructure. Managing surface water discharges from new development is therefore crucial in managing and reducing flood risk to new and existing development downstream. Carefully planned development can also play a role in reducing the amount of properties that are directly at risk from surface water flooding.

The Department for Communities and Local Government (DCLG) (now Ministry of Housing, Community and Local Government (MHCLG)) announced, in December 2014, that the local planning authority, in consultation with the LLFA, should be responsible for delivering SuDS[18] through the planning system. The Town and Country Planning (Development Management Procedure) (England) Order 2015 (as amended) gave provisions for major development (including ten or more dwellings or a building or buildings where the floor space is 1,000 square metres or more) to require sustainable drainage within the development proposals in accordance with the 'non-statutory technical standards for sustainable drainage systems'[19], published in March 2015. These Defra Technical Standards are set to be updated in early 2021. A Practice Guidance[20] document has also been developed by the Association of SuDS Authorities (ASA) (previously LASOO) to assist in the application of the non-statutory technical standards.

The Design and Construction Guidance (DCG) for sewers became the new regulated sewerage guidance on 1 April 2020. This allows water and sewerage companies to adopt SuDS components that meet the DCG. Details on the sewerage sector guidance can be found via:

https://www.water.org.uk/wp-content/uploads/2020/01/Water-UK-SuDS-brochure.pdf

Lancashire County Council Sustainable Drainage

LCC encourages prospective developers to first contact the local planning authority to determine whether your development proposal is acceptable in principle and on a planning policy basis.

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18 http://www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2014-12-18/HCWS161/

19 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

20 http://www.susdrain.org/files/resources/other-guidance/lasoo_non_statutory_suds_technical_standards_guidance_2016_.pdf

LCC offers a site-specific pre-application service where developers can receive advice on their development proposals and Land Drainage Consents that may be required for a fee.

https://www.lancashire.gov.uk/council/planning/sustainable-drainage-systems/

A new SuDS pro-forma and accompanying guidance have been created for LPAs to consider adopting as part of their planning documentation. This has been created for the North West, sponsored and endorsed by the North West RFCC, and has been developed by a task group of representatives from UU, North West Local Authorities and the EA. The guidance and pro-forma encourage the creation of high quality SuDS by allowing water quality, amenity and biodiversity as well as water quantity to be properly considered during the design stage and allowing it to be fully integrated into the surface water management and development design process. The new pro-forma supports and encourages SuDS design in line with The SuDS Manual C753 and the DCG for sewers. This is recognised nationally as best practice.

The SuDS pro-forma and supporting guidance are available via:

https://thefloodhub.co.uk/planning-development/#section-4

6.7.1 SuDS and the revised NPPF, 2021

The Revised NPPF (2021), para 169, states:

"Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a. take account of advice from the lead local flood authority;

b. have appropriate proposed minimum operational standards;

c. ***have maintenance arrangements, in place to ensure an acceptable standard of operation for the lifetime of the development;*** *and*

d. where possible, provide multifunctional benefits".

All developments, both major and minor, are to include SuDS, providing multiple benefits that contribute to many other NPPF policies, including climate change, biodiversity net gain, amenity and water quality improvements. Where site conditions may be more challenging, the SuDS components used will need to accommodate the site's opportunities and constraints. At a strategic level, this should mean identifying opportunities for a variety of SuDS components according to geology, soil type, topography, groundwater / mine water conditions, their potential impact on site allocation, and setting out local SuDS guidance and opportunities for in perpetuity adoption and maintenance. SuDS can be a fully piped system, but which attenuate underground and restrict discharge to rates agreed with the LPA in consultation with the LLFA. All new developments should be using SuDS unless it can be evidenced that they are unsuitable. This can be achieved by using the SuDS pro-forma.

In terms of what kind of evidence would show SuDS to be inappropriate for a certain site, it is possible that clarity on what evidence is required may be subsequently set out in the revised FRCC-PPG and the SuDS pro-forma, and that these circumstances would be exceptional.

Maintenance options must clearly identify who will be responsible for SuDS maintenance and funding for maintenance should be fair for householders and premises occupiers; and, set out a minimum standard to which the sustainable drainage systems must be maintained.

Sustainable drainage is a fundamental part of integrated design methodology and the proposed design should be secured by detailed planning conditions to ensure that the

SuDS is constructed, validated and maintained to a minimum level of effectiveness in accordance with SuDS proposals agreed by the LPA, in consultation with the LLFA.

6.7.2 SuDS hierarchy

The runoff destination should always be the first consideration when considering design criteria for SuDS including the following possible destinations in order of preference:

a) Source control / interception

1 Into the ground (infiltration);
2 To a surface water body;
3 To a surface water sewer, highway drain, or another drainage system;
4 To a combined sewer.

Effects on water quality should also be investigated when considering runoff destination in terms of the potential hazards arising from development and the sensitivity of the runoff destination. Developers should also establish that proposed outfalls are hydraulically capable of accepting the runoff from SuDS through desktop and site investigations and consultation with the LLFA, UU and Yorkshire Water as appropriate.

In the Pendle Local Plan Part 1: Core Strategy, Policy ENV7: Water Management notes that:

"All Brownfield development will be required to demonstrate that there will be a reduction of at least 30% in existing runoff rates, rising to a minimum of 50% in critical drainage areas (Pendle Council has NOT agreed to any percentage reduction targets for Brownfield development of Greenfield development discharge).

Any proposal for development on a Greenfield site, must demonstrate no alteration to runoff rates upon completion. Peak discharge should be restricted to five litres per second per hectare, this also being the requirement for sites of less than one hectare. Any additional volume of runoff must be taken into account by providing storage capacity within the surface water drainage system."

The EA may also look at the potential impact of an outfall structure through the planning consultation and Environmental Permitting Regulation process. It should be noted that detailing modelling will not be available for all outfalls therefore developers should carry out their own investigations whilst referring to the non-statutory technical standards for sustainable drainage systems (March 2015, due to be updated in 2021.

The non-statutory technical standards sets out appropriate design criteria based on the following:

1 Flood risk outside the development;
2 Peak flow control;
3 Volume control;
4 Flood risk within the development;
5 Structural integrity;
6 Designing for maintenance considerations;
7 Construction.

Many different SuDS techniques can be implemented. As a result, there is no one standard correct drainage solution for a site. In most cases, using the Management Train principle (see Figure 6-5), will be required, where source control is the primary aim.

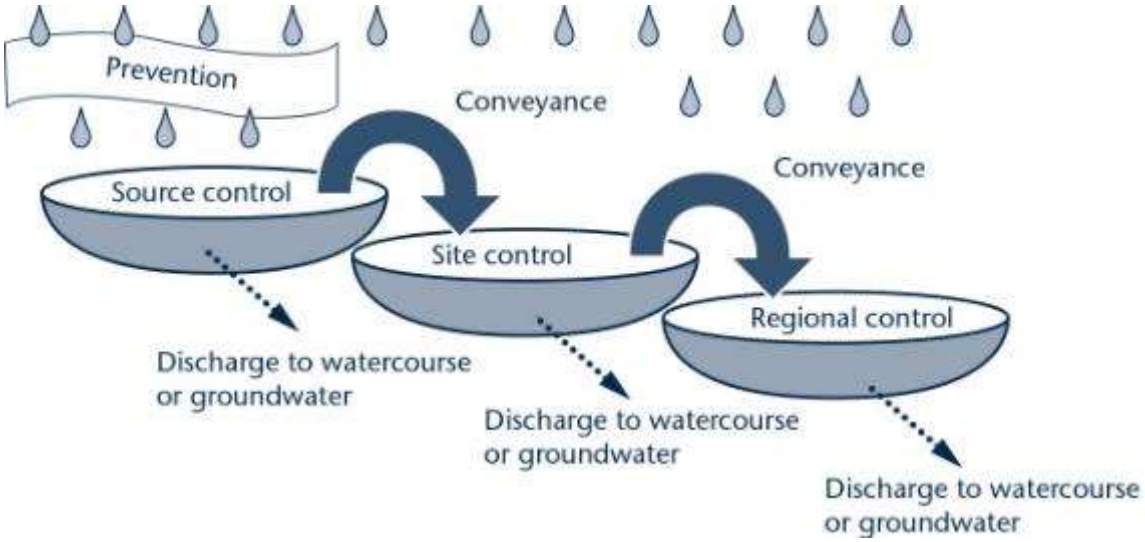

Figure 6-5: SuDS management train principle

The effectiveness of a flow management scheme within a single site is heavily limited by land use and site characteristics including (but not limited to) topography, geology and soil (permeability); and available area. Potential ground contamination associated with urban and former industrial sites should be investigated with concern being placed on the depth of the local water table and potential contamination risks that will affect water quality. The design, construction and ongoing maintenance regime of any SuDS scheme must be carefully defined as part of a site-specific FRA. A clear and comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential for successful SuDS implementation.

In addition to the national standards, the LPA may set local requirements for planning permission that include more rigorous obligations than the non-statutory technical standards. More stringent requirements should be considered where current Greenfield sites lie upstream of high-risk areas. This could include improvements on Greenfield runoff rates. The LPA should always be contacted with regards to its local requirements at the earliest opportunity in development planning.

The CIRIA SuDS Manual[21] 2015 should also be consulted by the LPA and developers. The SuDS manual (C753) is highly regarded and incorporates the latest research, industry practice, technical advice and adaptable processes to assist in the planning, design, construction, management and maintenance of good SuDS. The SuDS Manual complements the non-statutory technical standards and goes further to support the cost-effective delivery of multiple benefits.

6.8 Sustainable drainage for new developments

Development has the potential to cause an increase in impermeable area, an associated increase in surface water runoff rates and volumes, and a consequent potential increase in downstream flood risk due to overloading of sewers, watercourses, culverts and other drainage infrastructure.

Managing surface water discharges from new development is crucial in managing and reducing flood risk to new and existing development.

Carefully planned development can also play a role in reducing the amount of properties that are directly at risk from surface water flooding. The Planning System has a key role to play in setting standards for sustainable drainage from new

21 https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx

developments and ensuring that developments are designed to take account of the risk from surface water flooding. Sustainable drainage plays an important part in reducing flows in the sewer network and in meeting environmental targets, alongside investment in maintenance by the water companies on their assets. Water companies plan their investment on a five year rolling cycle, in consultation with key partners, including the EA and local authorities.

6.8.1 Overland flow paths

Underground drainage systems have a finite capacity and regard should always be given to larger events when the capacity of the network will be exceeded. Hence there is a need to design new developments with exceedance in mind. This should be considered alongside any surface water flows likely to enter a development site from the surrounding area.

All development proposals including masterplanning should ensure that existing overland flow paths are retained within the development. As a minimum, the developer should investigate, as part of a site-specific Flood Risk Assessment, the likely extents, depths and associated hazards of surface water flooding on a development site, as shown by the RoFSW dataset. This is considered to be an appropriate approach to reduce the risk of flooding to new developments. Blue-green infrastructure (BGI) should be used wherever possible to accommodate such flow paths. **Floor levels should always be set above the design flood based on EA guidance and the conclusions of the site-specific FRA** to reduce the consequences of any localised flooding, unless local guidance states otherwise.

The effectiveness of a flow management scheme within a single site is heavily limited by site constraints including (but not limited to) topography; geology and soil (permeability); development density; existing drainage networks both onsite and in the surrounding area; 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.

6.9 Property Flood Resilience (PFR)

PFR measures should only be applied retrospectively to existing development that is at flood risk, as new development should not be constructed in areas at flood risk. Para 163 of the NPPF explains that development must only be allowed in areas at flood risk where, following the Sequential and Exception Tests, and supported by an FRA, the development is appropriately flood resistant and resilient.

Flood resilience and resistance measures are mainly designed to mitigate flood risk and reduce damage and adverse consequences to existing property. Resistance and resilience measures may aim to help residents and businesses recover more quickly following a flood event.

It should be noted that it is not possible to completely prevent flooding to all communities and businesses.

Research carried out by the then DCLG, now MHCLG, and the EA has recommended that the use of resistance measures should generally be limited to a nominal protection height of 600mm above ground level, the lowest point of ground abutting the external property walls. This is because the structural integrity of the property may be compromised above this level.

It should be noted that PFR measures would not be expected to cause an increase in flood risk to other properties or other parts of the local community. They will help mitigate against flood risk but, as with any flood alleviation scheme, flood risk cannot

be removed completely. Emergency plans should, therefore, be in place that describe the installation of measures and residual risks.

As the flood risk posed to a property cannot be removed completely, it is recommended that PFR products are deployed in conjunction with pumps of a sufficient capacity. Pumps help manage residual flood risks not addressed by resistance measures alone such as rising groundwater.

6.9.1 Definitions

Flood resilience measures aim to reduce the damage caused by floodwater entering a property. Flood resilience measures are based on an understanding that internal flooding may occur again and when considering this eventuality, homes and businesses are encouraged to plan for flooding with an aim of rapid recovery and the return of the property to a habitable state.

For example, tiled floors are easier to clean than carpets, raised electricity sockets and high-level wall fixings for TVs / computers may mean that that power supply remains unaffected. Raising kitchen or storage units may also prevent damage that may not require replacement after a flood. There is a lot of information available about what items get damaged by floodwater and features that are considered to provide effective resilience measures that can be installed at a property.

Flood resistance measures aim to reduce the amount of floodwater entering the property. Obvious inflow routes, such as through doors and airbricks may be managed, for example, by installing bespoke flood doors, door flood barriers and automatic closing airbricks. However, the property's condition and construction are also key to understanding how floodwater may enter and move between buildings. For example, flood water can also flow between properties through connecting cavity walls, cellars, beneath suspended floors and through internal walls. Flood resistance measure alone may not keep floodwater out. Building condition is a critical component of any flood mitigation study.

6.9.2 Property mitigation surveys

To define the scale and type of resistance or resilience measures required, a survey will need to be undertaken to pick up property threshold levels, air brick levels, doorways, historic flood levels and a number of ground spot levels required to better understand the flood mechanisms for flood water arriving at the property (e.g. along road, pavements, etc.). The depth of flooding at each property will help guide the selection of resistance measures proposed. Surveys will need to include consideration of issues such as:

- Detailed property information
- An assessment of flood risk, including property (cross) threshold levels
- Routes of water ingress (fluvial, ground and surface water flooding)
- An assessment of impact of flood waters
- A schedule of measures to reduce risk (resistance and resilience)
- Details of recommendations (including indicative costs)
- Advice on future maintenance of measures
- Advice on flood preparedness

All sources of flooding will need to be considered, including a comprehensive survey of openings (doors, windows and air bricks), as well as potential seepage routes through walls and floors, ingress through service cables, pipes, drains and identify possible weaknesses in any deteriorating brickwork or mortar.

7 Emergency Planning

The provisions for emergency planning for local authorities as Category 1 responders are set out by the Civil Contingencies Act, 2004 and the National Flood Emergency Framework for England, December 2014[22]. This framework is a resource for all involved in emergency planning and response to flooding from the sea, rivers, surface water, groundwater and reservoirs. The Framework sets out Government's strategic approach to:

- Ensuring all delivery bodies understand their respective roles and responsibilities when planning for and responding to flood related emergencies;
- Giving all players in an emergency flooding situation a common point of reference which includes key information, guidance and key policies;
- Establishing clear thresholds for emergency response arrangements;
- Placing proper emphasis on the multi-agency approach to managing flooding events;
- Providing clarity on the means of improving resilience and minimising the impact of flooding events;
- Providing a basis for individual responders to develop and review their own plans; and
- Being a long-term asset that will provide the basis for continuous improvement in flood emergency management.

Along with the EA flood warning systems, there are a range of flood plans at a sub-regional and local level, outlining the major risk of flooding and the strategic and tactical response framework for key responders. The Environment Agency and the Association of Directors of Environment, Economy, Planning and Transport (ADEPT) have produced guidance on flood risk emergency plans for new development[23] (September 2019). It would however be for the LPA to review and approve flood risk emergency plans with their emergency planners.

This SFRA contains useful data to allow emergency planning processes to be tailored to the needs of the area and be specific to the flood risks faced. The SFRA Maps in Appendix B and accompanying GIS layers should be made available for consultation by emergency planners during an event and throughout the planning process.

7.1 Civil Contingencies Act

Under the Civil Contingencies Act (CCA, 2004)[24], the LLFA and LPAs are classified as Category 1 responders and thus have duties to assess the risk of emergencies occurring, and use this to:

- Inform contingency planning;
- Put in place emergency plans;
- Put in place business continuity management arrangements;
- Put in place arrangements to make information available to the public about civil protection matters;

[22] https://www.gov.uk/government/publications/the-national-flood-emergency-framework-for-england
[23] https://www.adeptnet.org.uk/floodriskemergencyplan
[24] https://www.gov.uk/preparation-and-planning-for-emergencies-responsibilities-of-responder-agencies-and-others#the-civil-contingencies-act

- Maintain arrangements to warn, inform and advise the public in the event of an emergency;
- Share information with other local responders to enhance coordination; and
- Cooperate with other local responders to enhance coordination and efficiency and to provide advice and assistance to businesses and voluntary organisations about business continuity management.

During an emergency, such as a flood event, the local authority must also co-operate with other Category 1 responders (such as the emergency services and the EA) to provide the core response.

7.1.1 Lancashire Local Resilience Forum (LRF)

The aim of the LRF is to legally deliver the duties stated in the Civil Contingencies Act 2004 within a multi-agency environment. The LRF is a group of organisations that work together to prepare and respond to emergencies in Lancashire. The LRF involves local authorities, emergency services, health agencies, Environment Agency and local businesses.

The LRF's common objectives are to:

- Prevent the situation from getting worse;
- Save lives;
- Relieve suffering;
- Protect property;
- Recover to normality as soon as possible;
- Facilitate criminal investigation and judicial process as necessary.

The LRF's main roles include:

- Assessing the impacts of the risk and providing this information to the public in a Community Risk Register;
- Creating emergency plans
- Responding together in a coordinated way
- Training and testing for preparedness
- Learning the lessons from incidents and exercises.[25]

7.1.2 Community Risk Register[26]

The LRF produces the Community Risk Register (CRR) which lists possible risks, the probability of occurring and potential impact. The CRR provides information on the biggest emergencies that happen in Lancashire, together with an assessment of how likely they are to happen and the impacts if they do include impacts to people, houses, the environment and local businesses. Each identified risk is then analysed and given a rating according to how likely the risk is to lead to an emergency and their potential impact on safety and security, health, economy, environment and society.

7.1.3 Community Emergency Plan

Communities may need to rely on their own resources to minimise the impact of an emergency, including a flood, before the emergency services arrive. Many

[25] https://www.stayintheknow.co.uk/EmergencyInfo

[26] https://www.lancashire.gov.uk/council/strategies-policies-plans/emergency-planning/risks-in-lancashire/

communities already help each other in times of need, but experience shows that those who are prepared cope better during an emergency. Communities with local knowledge, enthusiasm and information are a great asset and a Community Emergency Plan can help. Details on how to produce a community emergency plan, including a toolkit and template, are available from the Government's website[27]. LCC have produced guidance and emergency plans on how to prepare and respond to emergencies, these are available from:

https://www.lancashire.gov.uk/council/strategies-policies-plans/emergency-planning/emergency-plans/

7.1.4 Local flood plans

This SFRA provides a number of flood risk data sources that should be used when producing or updating flood plans. The LPA will be unable to write their own specific flood plans for new developments at flood risk. Developers should write their own. Generally, owners with individual properties at risk should write their own individual flood plans, however larger developments or regeneration areas, such as retail parks, hotels and leisure complexes, should consider writing one collective plan for the assets within an area.

The Flood Hub, a website funded by all of the LLFAs in the North West, has a wealth of materials located within their 'Knowledge Hub' which may support developers and communities at risk available via:

https://thefloodhub.co.uk/knowledge-hub/

This SFRA can help to:

- Update these flood plans if appropriate;
- Inform emergency planners in understanding the possibility, likelihood and spatial distribution of all sources of flooding (emergency planners may however have access to more detailed information, such as for Reservoir Inundation Maps, which have not been made available for this SFRA);
- Identify safe evacuation routes and access routes for emergency services;
- Identify key strategic locations to be protected in flooding emergencies, and the locations of refuge areas which are capable of remaining operational during flood events;
- Provide information on risks in relation to key infrastructure, and any risk management activities, plans or business continuity arrangements;
- Raise awareness and engage local communities;
- Support emergency responders in planning for and delivering a proportionate, scalable and flexible response to the level of risk; and
- Provide flood risk evidence for further studies.

The following guidance written by the Environment Agency and the Association of Directors of Environment, Economy, Planning and Transport is aimed at Local Planning Authorities to help assist in setting up their own guidelines on what should be included in the flood risk emergency plans:

https://www.adeptnet.org.uk/floodriskemergencyplan

As the LLFA LCC have produced a Local Flood Risk Management Strategy which explains how local flood risk is managed in Lancashire. The new strategy is currently out for consultation at the time of writing, so the current strategy is available here:

27 https://www.gov.uk/guidance/resilience-in-society-infrastructure-communities-and-businesses#community-resilience

https://www.lancashire.gov.uk/media/900474/lancashire-and-blackpool-local-flood-risk-management-strategy-consultation-draft.pdf

7.2 Flood warning and evacuation plans

Developments that include areas that are designed to flood (e.g. ground floor car parking and amenity areas) or have a residual risk associated with them, will need to provide appropriate flood warning and instructions so users and residents are safe in a flood. This will include both physical warning signs and written flood warning and evacuation plans. Those using the new development should be made aware of any evacuation plans.

In relation to new development it is up to the LPA to determine whether the flood warning and evacuation plans, or equivalent procedures, are sufficient or not. If the LPA is not satisfied, taking into account all relevant considerations, that an indicative development can be considered safe without the provision of safe access and exit, then planning permission should be refused.

Whilst there is no statutory requirement on the EA or the emergency services to approve evacuation plans, LPAs are accountable under their Civil Contingencies duties, via planning condition or agreement, to ensure that plans are suitable. This should be done in consultation with development management officers. Given the cross-cutting nature of flooding, it is recommended that further discussions are held internally to the LPA between emergency planners and policy planners / development management officers, the LLFA, drainage engineers and also to external stakeholders such as the emergency services, the EA, UU, YWS, Internal Drainage Boards and Canal and River Trust (if applicable).

It may be useful for the EA and spatial planners, and others as necessary to consider whether, as a condition of planning approval, flood evacuation plans should be provided by the developer which aim to safely evacuate people out of flood risk areas, using as few emergency service resources as possible. The Local Resilience Forum are essential to establish the feasibility / effectiveness of such an approach, prior to it being progressed. It may also be useful to consider how key parts of agreed flood evacuation plans could be incorporated within local development documents, including in terms of protecting evacuation routes and assembly areas from inappropriate development.

Once the development goes ahead, it will be the requirement of the plan owner (developer) to make sure the plan is put in place, and to liaise with the LPA and LLFA regarding maintenance and updating of the plan.

LCC have made information about what to do during a flood available online via: https://www.lancashire.gov.uk/flooding/during-a-flood/

This includes information on who to contact, what to before, during and after a flood.

Also, the Flood Hub has information relating to preparing and protecting against flood risk:

https://thefloodhub.co.uk/knowledge-hub/

7.2.1 What should the Plan include?

Flood warning and evacuation plans should include, as a minimum, the information stated in Table 7-1. Advice and guidance on plans are accessible from the EA website and there are templates available for businesses and local communities.

Consideration	Purpose
Availability of existing flood warning system	The EA offers a flood warning service that currently covers designated Flood Warning Areas in England and Wales. In these areas, they are able to provide a full Flood Warning Service.
Rate of onset of flooding	The rate of onset is how quickly the water arrives and the speed at which it rises which, in turn, will govern the opportunity for people to effectively prepare for and respond to a flood. This is an important factor within Emergency Planning in assessing the response time available to the emergency services.
How flood warning is given and occupants awareness of the likely frequency and duration of flood events.	Everyone eligible to receive flood warning should be signed up to the EA flood warning service. Where applicable, the display of flood warning signs should be considered. In particular sites that will be visited by members of the public on a daily basis such as sports complexes, car parks, retail stores. It is envisaged that the responsibility should fall upon the developers and should be a condition of the planning permission. Information should be provided to new occupants of houses concerning the level of risk and subsequent procedures if a flood occurs.
The availability of staff / occupants / users to respond to a flood warning and the time taken to respond to a flood warning	The plan should identify roles and responsibilities of all responders. The use of community flood wardens should also be considered.
Designing and locating safe access routes, preparing evacuation routes and the identification of safe locations for evacuees	Dry routes will be critical for people to evacuate as well as emergency services entering the site. The extent, depth and flood hazard rating, including allowance for climate change, should be considered when identifying these routes.
Vulnerability of occupants	Vulnerability classifications associated with development as outlined in the FRCC-PPG. This is closely linked to its occupiers.
How easily damaged items will be relocated, and the expected time taken to re-establish normal use following an event	The impact of flooding can be long lasting well after the event has taken place affecting both the property which has been flooded and the lives that have been disrupted. The resilience of the community to get back to normal will be important including time taken to repair / replace damages.

Table 7-1: Flood warning and evacuation plans

7.2.2 EA Flood Warning Areas (FWA) and flood awareness

The EA monitors river levels within the Main Rivers across England and, based upon weather predictions provided by The Met Office, make an assessment of the anticipated maximum water level that is likely to be reached within the proceeding hours (and/or days). Where these predicted water levels are expected to result in inundation of a populated area, the EA will issue a series of flood warnings within a defined FWA, encouraging residents to take action to avoid damage to property in the first instance.

More information on flood warnings is provided by the EA via:

https://www.gov.uk/government/publications/flood-warnings-what-they-are-and-what-to-do

There are 15 FWAs in operation across the study area. The FWA's are located along Pendle Water, Colne Water, and Earby Beck to protect the properties and businesses. The FWAs are shown on the SFRA maps in Appendix B.

Live information on flood warning and flood alerts for any location in England is available via:

https://flood-warning-information.service.gov.uk/

Emergency planners may also use the outputs from this SFRA to raise awareness within local communities. This should include raising awareness of flood risk, roles and responsibilities and measures that people can take to make their homes more resilient to flooding from all sources whilst also encouraging all those at fluvial flood risk to sign up to the EA's Flood Warning service.

https://www.gov.uk/sign-up-for-flood-warnings

It is also recommended that Category 1 responders are provided with appropriate flood response training to help prepare them for the possibility of a major flood with an increased number of people living within flood risk areas, to ensure that adequate pre-planning response and recovery arrangements are in place.

8 Summary and Recommendations

8.1 Summary

This Level 1 SFRA provides a single repository planning tool relating to flood risk and development in the Borough of Pendle. Key flood risk stakeholders namely the EA, LPA, LLFA, UU, YWS, local emergency services, emergency planners, local resilience forums, and Earby and Salterforth Drainage Board were consulted to collate all available and relevant flood risk information on all sources into one comprehensive assessment. Together with this main report, this SFRA also provides a suite of interactive GeoPDF flood risk maps (Appendix B) and a development site assessment spreadsheet (Appendix C) illustrating the level of risk to potential development sites.

The flood risk information, assessment, guidance and recommendations provided in this SFRA will provide the LPA with the evidence base required to apply the Sequential Test, as required under the NPPF, and demonstrate that a risk-based, sequential approach has been applied in the preparation of its new Local Plan.

Whilst the aim of the sequential approach is the avoidance of high flood risk areas, in some locations where the council is looking for continued growth and/or regeneration, this will not always be possible. This SFRA therefore provides the necessary links between spatial development, wider flood risk management policies, local strategies and plans and on the ground works by combining all available flood risk information together into one single repository. As this is a strategic study based on current available information, detailed, site-specific local information on flood risk is not fully accounted for. For a more detailed assessment of specific areas or sites, a Level 2 SFRA may be carried out following on from the completion of a Level 1 assessment, if required.

The data and information used throughout the SFRA process is the most up-to-date data available at the time of writing (March 2021). Once new, updated or further information becomes available, the LPA should look to update this SFRA. The Level 1 SFRA should be considered to be, and maintained as, a 'live' entity which is updated as and when required (when new modelling or flood risk information becomes available). The LPA and the LLFA can decide when to update the SFRA, and the EA as a statutory consultee on local plans can also advise on when an update is required to inform the local plan evidence base.

8.1.1 Summary of risk

The risk across the PBC area is varied:

- The main fluvial risk comes from:
  - Earby Beck that affects the town of Earby and the area south of Salterforth;
  - Stock Beck that affects the area north of Barnoldswick;
  - Pendle Water affecting Barrowford and areas in the M65 Corridor close to Brierfield and Nelson; and
  - along Colne Water between Cotton Tree (east of Colne) and Barrowford.
- Surface water risk is spread across the whole of the Borough of Pendle. The main areas of risk are primarily centred around the Main Rivers;
- The areas with the highest levels of groundwater vulnerability are distributed across the whole of the Borough of Pendle with the main areas including Barnoldswick, Colne, and along the M65 Corridor; and

- The main reservoir risk according to the Reservoir Flood Map, is in the area east of Whitemoor Reservoir, which includes the village of Foulridge, and several areas located in the M65 Corridor close to Barrowford and Nelson from reservoirs such as Lower Ogden Reservoir and Lower Black Moss Reservoir.

8.2 Planning and flood risk policy recommendations

The following planning flood risk policy recommendations are designed to enable the LPA to use the information provided in this Level 1 SFRA to inform Local Plan policy direction:

Recommendation 1: No development within the functional floodplain…

…as per the National Planning Policy Framework (2019) and Flood Risk and Coastal Change Planning Practice Guidance, unless in exceptional circumstances such as for essential infrastructure, which must still pass the Exception Test, or where development is water compatible.

Development must not impede the flow of water within the functional floodplain nor should it reduce the volume available for the storage of floodwater. Sites (that contain small areas of functional floodplain) may still be developable if the site boundary can be removed from the functional floodplain or the site can accommodate the risk on site and keep the area of functional floodplain free from development or obstruction and allowed to flow freely.

Refer to tables 1 to 3 of the FRCC-PPG.

Recommendation 2a: Consider surface water flood risk…

…with equal importance alongside fluvial risk including possible withdrawal, redesign or relocation for sites at significant surface water risk.

Sustainable Drainage Systems on all new development must adhere to industry standards and to the applicable runoff discharge rate and storage volume allowances stated by the LLFA.

Site specific Flood Risk Assessments should always consider surface water flood risk management and options for on-site flood storage through appropriate SuDS. The LPA and LLFA must always be consulted during this process, as should United Utilities, Yorkshire Water and the EA, if required.

A Sustainable Drainage Strategy should always be submitted which clearly takes account of the findings of the site-specific Flood Risk Assessment and specify the proposed design, constructions, adoption and management and maintenance arrangements of the proposed SuDS components. The LPA and LLFA must always be consulted during this process, as should United Utilities, Yorkshire Water and the EA, if required.

Recommendation 2b: Use of appropriately sourced SuDS…

…required for all major developments of 10 or more residential units or equivalent commercial development. This is in accordance with Para 163 of the National Planning Policy Framework (2019).

As per the NPPF (2021), in terms of SuDS, development in areas at flood risk should only be permitted where SuDS are incorporated into the design, unless clear evidence suggests demonstrates this would be inappropriate.

SuDS scoping and design, as part of a Sustainable Drainage Strategy informed by the site-specific FRA, must be included within the early stages of the site design in order to incorporate appropriate SuDS within the development.

The LPA, LLFA, and United Utilities / Yorkshire Water (if appropriate) must be consulted during the site design stage and the FRA must be submitted to and approved by the LPA, considering all consultation with key stakeholders.

All SuDS must be designed to meet industry standards, as specified below, including any replacement standards/documents which update or are in addition to those listed:

- Lancashire County Council SuDS Guidance / Specification
- Interim national standards published in March 2015
- Technical Standards for Sustainable Drainage Systems (Defra)
- C753 The SuDS Manual
- The Design and Construction Guidance for Sewers (2020).

Recommendation 3: Sequential approach to site allocation and site layout...

...must be followed by the LPA to ensure sustainable development when either allocating land in Local Plans or determining planning applications for development.

The overall aim of the Sequential Approach should be to steer new development to low risk Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, the flood risk vulnerability of land uses and reasonably available sites in Flood Zone 2 should be considered, applying the Exception Test if required.

Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in higher risk Flood Zone 3a, be considered. This should take into account the flood risk vulnerability of land uses, residual surface water and/or groundwater flood risk and the likelihood of meeting the requirements of the Exception Test, if required.

This SFRA, the NPPF and FRCC-PPG must be consulted throughout this process along with the LPA, LLFA, EA, UU and YWS.

Recommendation 4: recommended requirement for a site-specific Flood Risk Assessment...

...from a developer when a site is:

- Any site located within Flood Zone 2 or 3
- Any site that has an area greater than 1 ha
- Within Flood Zone 1 where any part of the site is identified by the Risk of Flooding from Surface Water maps as being at risk of surface water flooding.
- Identified by the EA as having critical drainage problems (within an Area with Critical Drainage Problems)
- Situated over or within 8 metres of a culverted watercourse or where development will be required to control or influence the flow of any watercourse
- Within 20 metres of a Main River
- Identified as being at increased flood risk in future
- At risk of flooding from other sources of flooding or at residual risk
- Subject to a change of use to a higher vulnerability classification which may be subject to other sources of flooding
- Situated in an area currently benefitting from defences
- Within a council designated Critical Drainage Area

Before deciding on the scope of the Flood Risk Assessment, this SFRA should be consulted along with the LPA, LLFA, UU and YWS. The Flood Risk Assessment should be submitted to and be approved by the LPA including suitable consultation with the LLFA and the EA and any other applicable parties.

Recommendation 5: Natural Flood Management techniques…

…must be considered, where possible, to aid with flood alleviation and implementation of suitable SuDS, depending on the location.

The national Working with Natural Processes mapping (included in this SFRA) should be consulted in the first instance, followed by local investigation into whether such techniques are appropriate and whether the benefits are proportionate to the work required to carry out the identified Working with Natural Processes approaches.

Natural drainage features should be maintained and enhanced and there should be a presumption against culverting of open watercourses. Where possible, culvert removal should be explored.

Recommendation 6: Phasing of development…

…must be carried out by the Local Planning Authority on a site by site basis and also within sites by the developer to avoid any cumulative impacts of flood risk (reinforced by the revised National Planning Policy Framework (2019)).

Using a phased approach to development, should ensure that any sites at risk of causing flooding to other sites are developed first to ensure that flood storage measures are in place and operational before other sites are developed, thus contributing to a sustainable approach to site development during all phases of construction. It may be possible that flood mitigation measures put in place at sites upstream could alleviate flooding at downstream or nearby sites.

Development phasing within large strategic sites of multiple developments should also be considered where parts of such sites are at flood risk.

The EA states that the optimum approach would be to have all development sites that make up a large strategic site to have all developers sign up to a Flood Risk and Drainage Masterplan from the very start of the planning stage. It is often the case that outline planning permission is given for larger strategic sites with individual developers then submitting further separate site-specific FRAs that are not joined up with the rest of the site. These individual FRAs can then fail to include the green SuDS infrastructure indicated within the Outline FRA.

Recommendation 7: Planning permission for at risk sites…

…can only be granted by the LPA where a site-specific Flood Risk Assessment shows that:

- The NPPF and FRCC-PPG have been referenced together with appropriate consultation with the LLFA, the EA, UU and Yorkshire Water, where applicable
- The effects of climate change have been taken into account using the latest allowances developed by the EA
- There is no loss in floodplain storage resulting from the development i.e. where development takes place in a fluvial flood zone or is at risk from surface water flooding, compensatory storage must be found to avoid loss of floodplain and subsequent displacement of water which may cause flooding elsewhere
- The development will not increase flood risk elsewhere
- For previously developed sites, the development should look to meet greenfield runoff rates where practicable (in line with the Non-Statutory Technical Standards for Sustainable Drainage (March 2013)), achieved through providing Sustainable Drainage Systems as appropriate or through the use of appropriate flow and volume control devices.
- There is no adverse effect on the operational functions of any existing flood defence infrastructure
- Proposed resistance / resilience measures designed to deal with current and future risks are appropriate
- Whether the development will be safe for its lifetime and has passed the Exception Test, if applicable
- An appropriate Emergency Plan is included that accounts for the possibility of a flood event and shows the availability of safe access and egress points accessible during times of flood.

8.2.1 Recommendations for further work

The SFRA process has developed into more than just a planning tool. Sitting alongside the SA, LFRMS and FRMP, it can be used to provide a much broader and inclusive vehicle for integrated, strategic and local flood risk management and delivery.

There are a number of plans and assessments listed in Table 8-1 that may be of benefit to the LPA, in developing their flood risk evidence base to support the delivery of the Local Plan, or to the LLFA to help fill critical gaps in flood risk information that have become apparent through the preparation of this Level 1 SFRA.

Type	Study	Reason	Timeframe
Understanding of local flood risk	Level 1 SFRA update	When there are changes to: • the predicted impacts of climate change on flood risk • detailed flood modelling - such as from the EA or LLFA • the local plan, spatial development strategy or relevant local development documents • local flood management schemes	As required

Type	Study	Reason	Timeframe
		• flood risk management plans • shoreline management plans • local flood risk management strategies • national planning policy or guidance Or after a significant flood event.	
	Level 1 SFRA update; Level 2 SFRA; site-specific FRA	Reviewing of EA flood zones in those areas not covered by existing detailed hydraulic models i.e. the Flood Map for Planning does not cover every watercourse such as those <3km^2 in catchment area or Ordinary Watercourses. If a watercourse or drain is present on OS mapping but is not covered by the Flood Map for Planning, this does not mean there is no potential flood risk. A model may therefore be required to ascertain the flood risk, if any, to any nearby sites.	Short term
	Level 2 SFRA	**Further, more detailed assessment of flood risk to high risk sites, large strategic sites, as notified by this Level 1 SFRA. Dependant on the availability EA river model data. If EA model data is unavailable, a developer may be expected to undertake their own modelling**	**Short term**
	Preliminary site-screening FRAs / outline drainage strategy	Further, more detailed assessment of larger strategic sites.	Short term
	Local Flood Risk Management Strategy Review	It is recommended that the LFRMS is updated to ensure it remains consistent with the National Flood and Coastal Erosion Risk Management Strategy that was updated and published July 2020.	Short term
	SWMP / drainage strategy / detailed surface water modelling	LCC has not developed a SWMP for the district. An initial strategic part of SWMP investigations has been carried out, however. It is recommended that the LLFA uses information from this SFRA to ascertain whether certain locations at high surface water flood risk may benefit from a SWMP or a detailed surface water modelling study.	Short to Medium term
	Water Cycle Study	LCC has not developed a WCS for the borough. If the Local Plan highlights large growth and urban expansion, the LLFA should produce a WCS to look at	Short to Medium term

Type	Study	Reason	Timeframe
		capabilities of water and sewerage providers.	
	Climate change assessment for Level 1 update or Level 2 SFRA	Modelling of climate change, using the EA's 2016 allowances. February 2016 allowances for updated EA models are currently used. Guidance has been revised in line with UKCP18 where the guidance has changed on how to apply peak river flow allowances so the approach is the same for both flood zones 2 and 3. This should also be updated in line with future revisions of the climate change allowances PPG.	Short term
	Possible CDA delineation	Whether the delineation of CDAs may be appropriate for areas particularly prone to surface water flooding. Detailed analysis and consultation with the LLFA, YWS, UU and any relevant Internal Drainage Board would be required. It may then be beneficial to carry out a local SWMP or drainage strategy for targeted locations with any such critical drainage problems.	Medium term
Flood storage and attenuation	Community Infrastructure Levy (CIL) and Blue-Green Infrastructure (GI)	For new developments, BGI assets can be secured from a landowner's 'land value uplift' and as part of development agreements. The LPA could include capital for the purchase, design, planning and maintenance of BGI within its CIL programme.	Short term
	Working with Natural Processes	Promote creation of floodplain and riparian woodland, floodplain reconnection and runoff attenuation features where the research indicates that it would be beneficial in Pendle.	Ongoing
Data collection	Flood Incident data	LCC, as LLFA, has a duty to investigate and record details of significant flood events within their area. General data collected for each incident, should include date, location, weather, flood source (if apparent without an investigation), impacts (properties flooded or number of people affected) and response by any Risk Management Authority.	Short term
	FRM Asset Register	LCC has a responsibility to update and maintain a register of structures and features, which are considered to have an effect on flood risk.	Ongoing
Capacity	SuDS review / guidance	The LPA should work with the LLFA to clearly identify its requirements of developers for SuDS in new developments. The LLFA would encourage the creation of	Short Term / Long Term

Type	Study	Reason	Timeframe
		a SuDS SPD and robust policy in the DPD to secure maximum weighting is applied to surface water management and sustainable design of new drainage systems to prevent flooding from surface water.	
Partnership	United Utilities / Yorkshire Water	The LLFA should continue to collaborate with UU/YWS on sewer and surface water projects. The LPA should be kept informed and carry out an assessment of water company assets to ensure they are operational and resilient at all times across the catchment and that capacity for new development is appropriate.	Ongoing
	EA	PBC and LCC should continue to work with the EA on fluvial flood risk management projects. Potential opportunities for joint schemes to tackle flooding from all sources should be identified.	Ongoing
	Community	Continued involvement with the community through LCC's existing flood risk partnerships.	Ongoing

Table 8-1: Recommended further work for PBC or developers

8.2.2 Level 2 SFRA

The LPA should review the sites where they expect the main housing numbers and employment sites to be delivered, using Section E.1 of Appendix E, the SFRA maps in Appendix B and the development site assessment spreadsheet in Appendix C. A Level 2 SFRA may be required for sites where any of the following applies:

- The Exception Test is required,
- Further evidencing i.e. climate change modelling is required at the strategic level in order to allocate,
- A large site, or group of sites, are within Flood Zone 3 and have strategic planning objectives, which means they cannot be relocated or avoided,
- A cluster of sites are within Flood Zone 2 or are at significant risk of surface water flooding.

A Level 2 SFRA should build on the source information provided in this Level 1 assessment and should show that a site will not increase risk elsewhere and will be safe for its lifetime, once developed.

As discussed in Section 6.5, a Level 2 assessment can be used to model the February 2016 climate change allowances, where current EA models are available. A Level 2 study may also further assess locations and options, in more detail, for the implementation of open space, or Green Infrastructure, to help manage flood risk in key areas, and also to assess residual risk.

Ultimately, the LPA will need to provide evidence in its Local Plan to show that housing numbers, economic needs and other sites can be delivered. Proposals within the Local Plan may be rejected if a large number of sites require the Exception Test to be passed but with no evidence that this will be possible.

As sites within this Level 1 assessment have been reviewed by the LPA in the consideration of planning applications, then further advice or guidance may be required to establish how best to progress future development proposals, possibly by a further review of the SFRA.

All Strategic Recommendation B sites should have a Level 2 SFRA completed assuming the LPA want to allocate. Those sites with Strategic Recommendation A should be withdrawn based on significant levels of fluvial and/or surface water flooding; if a site is still going to be taken forward then a Level 2 assessment should be carried out to assess depths and hazards of flooding in order for the site to pass the Exception Test (if applicable). Certain Strategic Recommendation C sites may also benefit from a more in-depth assessment through a Level 2 SFRA.

The EA should always be consulted as to whether a Level 2 SFRA is required

Appendices

A Planning Framework and Flood Risk Policy

Following the introduction to the planning framework and flood risk policy located in Section 4, the remainder of the policy information is located within Appendix A and gives background into the policy documents that are relevant to PBC.

B SFRA maps

Interactive GeoPDF maps

The SFRA Maps consist of all flood risk information used within the SFRA, by way of interactive GeoPDFs. Open the Overview Map in Adobe Acrobat. The Overview Map includes a set of five squares; clicking on one of these squares will open up on of the Index Maps. The Index Maps then contains a set of index squares covering the authority area at a scale of 1:10,000. Clicking on one of these index squares will open up a more detailed map of that area (scale = 1:10,000) by way of a hyperlink.

Within the detailed maps, use the zoom tools and the hand tool to zoom in/out and pan around the open detailed map. In the legend on the right-hand side of the detailed maps, layers can be switched on and off when required by way of a dropdown arrow. The potential development site reference labels can also be switched on and off if, for example, smaller sites are obscured by labels.

The table below shows the datasets that are included in the maps with a short description of what they show.

Dataset	Description
Areas Benefitting from Defences	This dataset shows those areas that benefit from the presence of defences in a 1 in 100 (1% AEP) chance of flooding each year from rivers; or 1 in 200 (0.5% AEP) chance of flooding each year from the sea (not applicable to PBC). Note: in mapping these areas, it is assumed that flood defences and other operating structures act perfectly and give the same level of protection as when the assessment of the area was done.
BGS Potential for Groundwater Flooding map	Dataset from the British Geological Survey shows which areas are susceptible to groundwater flooding classified into three categories.
PBC Boundary	A shapefile showing PBC's administrative area.
Climate Change Modelled Flood Outlines	Climate change modelled flood outlines from the EA hydraulic models Earby Beck 2018 model, and Hendon Brook 2018 model.
Detailed River Network	EA dataset symbolised to show the Main Rivers and Ordinary Watercourses flowing through the study area.
Earby and Salterforth Internal Drainage Board Boundary	A shapefile showing the administrative boundary of the Earby and Salterforth IDB.
Flood Alert Areas	EA dataset showing geographical areas where it is possible for flooding to occur from rivers, sea and in some locations, groundwater. Flood Alerts are issued to warn people of the possibility of flooding and encourage them to be alert, stay vigilant and make early/low impact preparations for flooding.
Flood Warning Areas	EA dataset showing geographical areas where we expect flooding to occur and where the Environment Agency provide a Flood Warning Service.

Dataset	Description
Flood Zone 3b (functional floodplain)	The functional floodplain was delineated as part of this 2020 SFRA (see Appendix D for methodology note) as it is not included in the Flood Map for Planning. This zone is for the use of LPAs and developers.
Flood Zones 2 and 3	The flood zones that are included within the EA's Flood Map for Planning. Note: the SFRA splits Flood Zone 3 into Flood Zone 3a and Flood Zone 3b.
Historic Flood Map	EA dataset showing the maximum extent of all individual Recorded Flood Outlines from river, the sea and groundwater. It differs from the Recorded Flood Outlines dataset as the HFM only contains outlines that are 'considered and accepted'.
LLFA Boundary	A shapefile of LCC's administrative area.
Main River buffer	EA guidance states that a buffer is required along all watercourses, which may be needed for access, maintenance or future flood risk management to make sure development in these areas does not increase flood risk. An 8-metre buffer, either side of each watercourse, has therefore been used in this SFRA, based on typical EA advice. Note: this buffer area is indicative and any plans for development should, through an FRA, further investigate the area required for the buffer zone.
Recorded Flood Outlines	EA dataset showing all records of historic flooding from rivers, the sea, groundwater and surface water. This dataset contains a consistent list of information about the recorded flood.
Risk of Flooding from Rivers and Sea (RoFRS)	EA dataset showing the chance of flooding from rivers and/or the sea, based on cells of 50m. Each cell is allocated one of four flood risk categories, accounting for flood defences and their condition.
Risk of Flooding from Surface Water (RoFSW)	EA dataset, previously known as the updated Flood Map for Surface Water (uFMfSW); shows the extent of flooding from surface water that could result from a flood. Note: this data should not be used at the property level for detailed planning decisions.
Spatial Flood Defences	EA dataset showing all flood defences currently owned, managed or inspected by the EA. It has been symbolised to show manmade raised flood walls and embankments within the study area and also the condition of those assets.
United Utilities Boundary	A shapefile showing the area covered by United Utilities.
Working with Natural Processes	EA dataset showing the potential for Working with Natural Processes interventions that can be used to identify areas where more natural forms of flood management may be beneficial.
Yorkshire Water Boundary	A shapefile showing the area covered by YWS.

C Development site assessment spreadsheet

Excel spreadsheet containing an assessment of flood risk to the potential development sites based on Flood Zones 2, 3a and 3b, as delineated through this SFRA, the Risk of Flooding from Surface Water (RoFSW), and climate change considerations. Each site then given a strategic recommendation based on risk.

D Functional floodplain delineation

Technical note explaining the methodology behind the delineation of the functional floodplain (Flood Zone 3b) for this SFRA.

E Strategic Recommendations of the proposed sites

Following on from the introduction to the strategic recommendations for sites and the site assessment spreadsheet in Appendix C, this Appendix details the strategic recommendations for sites.

F Strategic Recommendation figures

Figures mapping the sites across the study area categorised by strategic recommendation to easily show which sites may be allocated and those that may need more work before that is possible.

G Pendle Level 1 SFRA User Guide

A support document to provide guidance on the use of the SFRA to developers, spatial planners, development management, flood risk management and emergency planners.

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