Liverpool City Region Combined Authority Strategic Flood Risk Assessment

Part A

Revision 5.0

November 2023

Prepared for:

Liverpool City Region Combined Authority

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This report describes work commissioned by Liverpool City Region Combined Authority by an instruction dated 22 February 2023. The Client's representative for the contract was Emma Dyson of Liverpool City Region Combined Authority. Laura Thompson and Mike Williamson of JBA Consulting carried out this work.

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Abbreviations

ADEPT	Association of Directors of Environment, Economy, Planning and Transport
AEP	Annual Exceedance Probability
CAM	Condition Assessment Manual
CC	Climate Change
CCA	Civil Contingencies Act
CFMP	Catchment Flood Management Plan
CRR	Community Risk Register
CRF	Cheshire Resilience Forum
CSO	Combined Sewer Overflow
EA	Environment Agency
FAA	Flood Alert Area
FCERM	Flood and Coastal Erosion Risk Management
FMfP	Flood Map for Planning
FRA	Flood Risk Assessment
FRCC-PPG	Flood Risk and Coastal Change Planning Practice Guidance
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
FRR	Flood Risk Regulations
FSA	Flood Storage Area
FWA	Flood Warning Area
FWMA	Flood and Water Management Act
GI	Green Infrastructure
GIS	Geographical Information System
HFM	Historic Flood Map
IIA	Integrated Impact Assessment
LA	Local Authority
LCR	Liverpool City Region
LCRCA	Liverpool City Region Combined Authority
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LRR	Local Resilience Forum

mAOD ..... Metres Above Ordnance Datum
MRF ..... Merseyside Resilience Forum
NFM ..... Natural Flood Management
NGO ..... Non-governmental organisation
NPPF..... National Planning Policy Framework
PFR ..... Property Flood Resilience
PFRA..... Preliminary Flood Risk Assessment
RBMP ..... River Basin Management Plan
RBD..... River Basin District
RFCC ..... Regional Flood and Coastal Committee
RFM ..... Reservoir Flood Map
RMA ..... Risk Management Authority
RFO..... Recorded Flood Outline
RoFSW..... Risk of Flooding from Surface Water
SDS..... Spatial Development Strategy
SFRA..... Strategic Flood Risk Assessment
SIP ..... Strategic Infrastructure Plan
SMP ..... Shoreline Management Plan
SoP ..... Standard of Protection
SuDS..... Sustainable Drainage System
SWMP ..... Surface Water Management Plan
UKCP ..... United Kingdom Climate Projections
UU ..... United Utilities
WCS..... Water Cycle Study
WFD ..... Water Framework Directive
WwNP ..... Working with Natural Processes

Executive Summary

This regional Strategic Flood Risk Assessment (SFRA) has been undertaken to provide key, up-to-date, information and evidence concerning flood risk and its management at the City Region scale to inform the Liverpool City Region Combined Authority (LCRCA) Spatial Development Strategy (SDS).

This SFRA can be used to inform strategic policies for the SDS, including strategic growth locations whilst considering the latest national policy and guidance on planning and flood risk available at the time of writing, namely:

- National Planning Policy Framework[1] (NPPF), first published March 2012 and last updated July 2021,
- The accompanying flood risk and planning practice guidance, the Flood Risk and Coastal Change Planning Practice Guidance[2] (FRCC-PPG), first published in 2014 and last updated August 2022,
- EA Climate Change Allowances[3],
- The latest SFRA guidance, including
- 'How to prepare a strategic flood risk assessment[4]' guidance, March 2022, and
- The 'Strategic flood risk assessments a Good Practice Guide[5]' guidance, November 2021.

The above guidance is supplemented by the latest, key information and evidence concerning flood risk and its management on a strategic, City Region wide scale.

The SFRA is focused on collecting readily available flood risk information from a number of stakeholders, the aim being to help identify the number and spatial distribution of flood risk sources present throughout the City Region to inform the application of the sequential approach in the SDS's preparation.

The key objectives of this SFRA, in line with the above-mentioned guidance and, more specifically, with the LCRCA's project brief, are to:

- Provide a clear, up-to-date understanding and overview of flood risk from all sources (including fluvial from main rivers and ordinary watercourses and tidal

1 National Planning Policy Framework; Ministry of Housing, Communities & Local Government, 2021

2 Flood Risk and Coastal Change Planning Practice Guidance; Ministry of Housing, Communities & Local Government, 2022

3 Flood risk assessments: climate change allowances, Environment Agency, 2022

4 How to prepare a Strategic Flood Risk Assessment, Defra and Environment Agency, 2022

5 Strategic flood risk assessments A GOOD PRACTICE GUIDE, Report produced using Environment Agency research on 'using flood risk information in spatial planning' (2019-2020), 2021

risk from the sea (Flood Map for Planning and functional floodplain), surface water (pluvial), groundwater, sewer, and residual risk from reservoirs and canals, now and in the future, on which to inform SDS policies including spatial distribution options and the identification of future broad development / growth locations in the city region at a strategic level,

- Ensure that SDS policy and supporting evidence has been developed in line with national planning policy and relevant planning practice guidance insofar as it is proportionate and relevant to the strategic scope of the SDS where broad/strategic locations rather than sites are to be identified,
- Contribute towards the satisfaction of relevant SDS statutory plan making requirements including addressing climate change and its consequences in the City Region,
- Contribute to the existing body of work and evidence informing the Integrated Impact Assessment (IIA) of the SDS (which encompasses the Sustainability Appraisal) and Strategic Infrastructure Plan (SIP), and
- Contribute to the existing body of evidence on flood risk and flood risk management in the city region with identification of gaps/areas where evidence needs updating and provision of recommendations on how these could be addressed.

Note: this City Region wide SFRA is not intended to replace any existing flood related strategy documents such as the Level 1 and 2 SFRAs prepared by the constituent local planning authorities (LPAs) for local plan making and in the determination of planning applications.

Summary of risk

Based on the Flood Map for Planning:

- Tidal flood risk is greatest:
  - Sefton - Marshside and Crossens in the north; south of Formby and north of Hightown in the south,
  - Wirral - along the north coast around Leasowe and Meols and to large areas of agricultural land; Birkenhead from the Mersey Estuary; Bromborough Pool from Dibbinsdale Brook and Mersey Estuary; West Kirby along South Parade,
  - Liverpool - around the docks from the Mersey Estuary
  - Halton - north and east of Hale from the Mersey Estuary and Ram's Brook; Hale Bank from the Mersey Estuary and Ditton Brook.
- Fluvial risk is greatest:
  - Sefton - east of Formby; parts of Maghull,
  - Wirral - Birkenhead; Clatterbridge Hospital,
  - Liverpool - Norris Green,
  - Knowsley - Bowring Park; Halewood,

- Halton - Widnes; Keckwick,
- St Helens - Sutton; Peasley Cross; Denton's Green; Eccleston.

Areas at greatest risk from surface water according to the Risk of Flooding from Surface Water map are difficult to define. It is clear that the majority of urban areas are at some risk from surface water flooding.

Based on the JBA 5m Groundwater Flood Map, the majority of Sefton, particularly Crossens, Marshside, Maghull and Aintree are at risk. Other notable locations at higher risk include Netherley and Belle Vale in Liverpool; Stockbridge Village and Huyton in Knowsley; St Helens town centre, Rainford and Newton le Willows in St Helens; Clatterbridge Hospital and Woodchurch in Wirral.

Reservoir flooding has the potential to affect all six districts within the City Region, with the areas with the most widespread risk being Knowsley, Halton and St Helens.

1 Introduction

1.1 Commission

The LCRCA commissioned JBA Consulting for the undertaking of a Strategic Flood Risk Assessment (SFRA) to inform the preparation of the Liverpool City Region Spatial Development Strategy (SDS). When published, the SDS will be used by the LCRCA and its constituent authorities to provide a strategic policy framework for future development plans and proposals.

The Liverpool City Region Combined Authority (LCRCA) is a Mayoral Combined Authority covering the six local authorities of Halton, Knowsley, Liverpool, Sefton, St. Helens and Wirral – the 'constituent authorities'. The constituent authorities each have their own responsibilities as Lead Local Flood Authorities (LLFA) and Local Planning Authorities (LPA).

At the time of publication, this regional SFRA considers the latest available guidance, the Environment Agency's (EA) latest climate change allowances and the most up to date functional floodplain mapping for the City Region. This information should help to inform any updates to the constituent authority's individual local plan SFRAs.

This SFRA can be used to inform strategic policies for the SDS, including strategic growth locations whilst considering the latest national policy and guidance on planning and flood risk available at the time of writing, namely:

- National Planning Policy Framework[6] (NPPF), first published March 2012 and last updated July 2021,
- The accompanying flood risk and planning practice guidance, the Flood Risk and Coastal Change Planning Practice Guidance[7] (FRCC-PPG), first published in 2014 and last updated August 2022,
- EA Climate Change Allowances[8],
- The latest SFRA guidance, including
    - 'How to prepare a strategic flood risk assessment[9]' guidance, March 2022, and

6 National Planning Policy Framework; Ministry of Housing, Communities & Local Government, 2021

7 Flood Risk and Coastal Change Planning Practice Guidance; Ministry of Housing, Communities & Local Government, 2022

8 Flood risk assessments: climate change allowances, Environment Agency, 2022

9 How to prepare a Strategic Flood Risk Assessment, Defra and Environment Agency, 2022

- the 'Strategic flood risk assessments a Good Practice Guide[10]' guidance, November 2021.

The above guidance is supplemented by the latest, key information and evidence concerning flood risk and its management on a strategic, City Region wide scale.

1.2 Objectives

The key objectives of this SFRA, in line with the above-mentioned guidance and, more specifically, with the LCRCA's project brief, are to:

- Provide a clear, up-to-date understanding and overview of flood risk from all sources (including fluvial from main rivers and ordinary watercourses and tidal risk from the sea (Flood Map for Planning and functional floodplain), surface water (pluvial), groundwater, sewer, and residual risk from reservoirs and canals, now and in the future, on which to inform SDS policies including spatial distribution options and the identification of future broad development / growth locations in the city region at a strategic level;
- Ensure that SDS policy and supporting evidence has been developed in line with national planning policy and relevant planning practice guidance insofar as it is proportionate and relevant to the strategic scope of the SDS where broad/strategic locations rather than sites are to be identified;
- Contribute towards the satisfaction of relevant SDS statutory plan making requirements including addressing climate change and its consequences in the LCR;
- Contribute to the existing body of work and evidence informing the Integrated Impact Assessment (IIA) of the SDS (which encompasses the Sustainability Appraisal) and Strategic Infrastructure Plan (SIP); and
- Contribute to the existing body of evidence on flood risk and flood risk management in the city region with identification of gaps/areas where evidence needs updating and provision of recommendations on how these could be addressed.

Note: this City Region wide SFRA is not intended to replace any existing flood related strategy documents such as the Level 1 and 2 SFRAs prepared by the constituent local planning authorities (LPAs) for local plan making and in the determination of planning applications. Planning decisions should be made with consideration to local guidance.

10 Strategic flood risk assessments A GOOD PRACTICE GUIDE, Report produced using Environment Agency research on 'using flood risk information in spatial planning' (2019-2020), 2021

1.3 Consultation

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

- 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;
- Relevant district councils (i.e. within the LCRCA and neighbouring districts); and
- Regional flood and coastal committees.

1.4 SFRA future proofing

This SFRA has been developed using the most up-to-date data and information available at the time of preparation. The SFRA has been future proofed as far as possible though the reader should always confirm with the source organisation (the LCRCA) 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 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 spatial development strategy or relevant local development documents,
- Local flood management schemes,
- Flood risk management plans,
- Shoreline management plans,
- Local flood risk management strategies, and
- National planning policy or guidance.

The SFRA should also be reviewed after a significant flood event. It is in any authority's interest to keep the SFRA as up to date as possible.

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

This SFRA uses the EA's Flood Map for Planning (FMfP) version issued in April 2023 to assess fluvial and tidal risk. The Flood Map for Planning is updated at quarterly

intervals by the EA as and when accepted 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 April 2023, via the following link: Flood Map for Planning

To assess the surface water risk to the potential development sites, this SFRA uses the EA's Risk of Flooding from Surface Water (RoFSW) dataset, last updated May 2021 at the time of writing. This dataset can be updated periodically when applicable local surface water modelling is carried out that adheres to the EA's required methodology. 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:

Check long term flood risk

2 Study Area

2.1 Liverpool City Region

The Liverpool City Region is situated in the north-west of England within the county of Merseyside and has an area of approximately 903 square kilometres, covering six Local Authority areas:

- Halton Borough Council
- Knowsley Metropolitan Borough Council
- Liverpool City Council
- Sefton Council
- St Helens Borough Council
- Wirral Council

The LCRCA is a strategic authority with powers over transport, economic development, regeneration and planning, and is also supported by the Liverpool City Region Local Enterprise Partnership. The LCRCA's initial Devolution Agreement in November 2015 saw an extra £900 million of funding secured over 30 years and identified a number of priority areas where resources and decision making would be controlled locally, including employment and skills, housing and planning, transport, innovation, business growth and support, energy, culture and finance. Devolution from central government has helped secure hundreds of millions of pounds in extra investment, that would otherwise not have come to the city region.

The LCRCA has secured £1billion in funding with £400m already invested in schemes to create jobs, improve transport, improve education facilities, reduce long term unemployment and support cultural events. 9,000 new jobs and 5,500 new apprenticeships have been created for local people through this funding.

According to the mid-2020 Office for National Statistics population estimates[11], the Liverpool City Region has a combined population of approximately 1.5 million people. The most populated area of the City Region is Liverpool with a population estimate of around 500,000. The north of the region is bordered by West Lancashire, whilst the east is bordered by the districts of Wigan and Warrington. Cheshire West and Chester border the City Region to the south. Flintshire (Wales) lies to the west across the River Dee Estuary.

The main river management catchments in the combined authority area are the Alt and Crossens catchment to the north and the Lower Mersey catchment to the south. In addition, the Weaver Gowy catchment is coincident with the south of the area at Halton. The principal channels within the area are the tributaries that enter the Mersey Estuary, and channels within Wirral and Sefton.

11 Office for National Statistics

2.2 Geology and topography

Due to the size of the region, the geology and topography are considerably varied. Much of the region is characterised by Sandstone and Conglomerate Bedrock, with this changing to Mudstone, Siltstone and Sandstone towards the north of the LCRCA around Sefton, and Coal Measures through areas across Knowsley and St Helens. The bedrock is overlain by superficial Till deposits across the majority of the region. Other deposits found within the LCRCA include Sand and Gravel along coastal areas and peat.

The topography of the region is varied, ranging from flat, low-lying land to the west along coastal reaches, to areas of higher elevation towards the east.

Halton is characterised by two distinctly different topographies north and south of the River Mersey. The north comprises low lying, flat land of approximately 5 mAOD, whilst the south is much higher in elevation.

The eastern area of the Knowsley boundary is characterised by higher elevation, whilst the western and south areas are flatter. Key settlements such as Huyton and Prescot are located within areas of higher elevation.

The majority of the land within the Liverpool boundary is at a higher elevation in comparison to the rest of the City Region. Areas along the coastline are at around 7 mAOD whereas the centre of the region is at approximately 65 mAOD.

Sefton is generally characterised by low lying land due to the coastal nature of the borough. The average elevation across the borough is around 10 mAOD.

St Helens contains the highest point within Merseyside and therefore its average elevation is a lot higher than the other areas of the City Region. The north-east and south-west of the boundary is comprised of considerably higher elevations than the centre of the borough which is relatively low-lying in comparison.

The topography of Wirral is relatively flat with gentle gradients. The highest point of Wirral is at Heswall Beacons on the Dee side of the borough, with other areas of higher ground at Birkenhead and Wallasey.

Figure 2-1 shows the topography of the City Region.

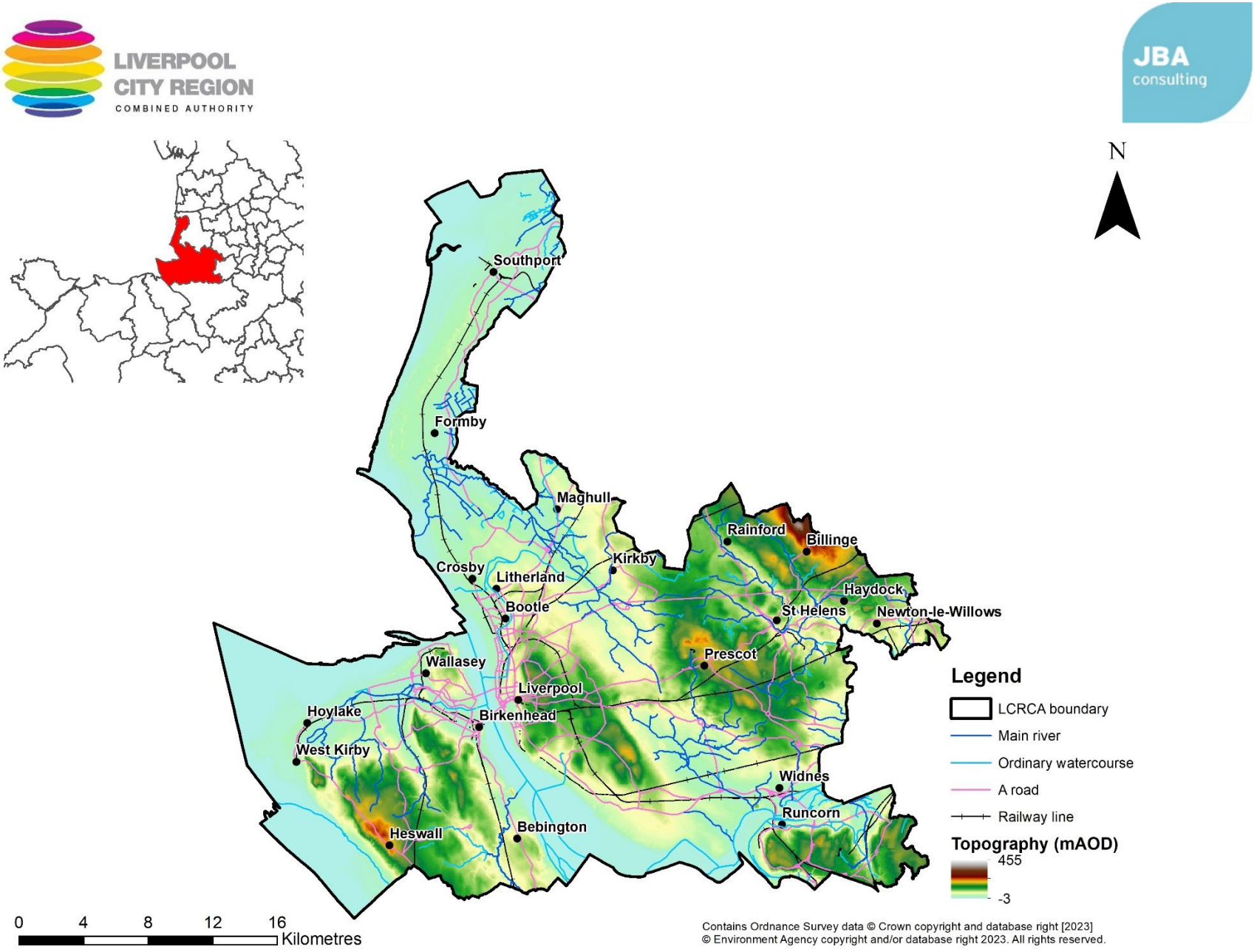

Figure 2-1: Topography, watercourses, and transport within the City Region

2.3 Main rivers

Main rivers are generally major watercourses for which the EA has permissive powers to carry out maintenance, improvement or construction work to manage flood risk. Under the Environmental Permitting (England and Wales) Regulation 2016, the EA also regulates development or works in, on, over, under, or within 8 metres of fluvial main river watercourses. This includes activities within the floodplain if works do not have planning permission and require quarrying or excavation within 16 metres of any main river, flood defence or culvert. The range of activities subject to regulation are listed online via: Flood risk activities: environmental permits

Whilst the EA has permissive powers to undertake works, the maintenance of main rivers is primarily the responsibility of riparian owners.

There are a considerable number of main river watercourses that flow through the City Region. The majority of these enter the City Region from the east and flow through the combined authority area where they meet the west coast at either Wirral or Sefton. Other main rivers are located in Halton (Ditton Brook, Stewards Brook and Keckwick Brook). Figure 2-2 shows the main rivers within the LCRCA.

2.4 Ordinary watercourses

Ordinary watercourses are any watercourse that is not designated 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. Such watercourses can be described as ephemeral watercourses.

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. The River Mersey is a key ordinary watercourse within LCRCA. Figure 2-2 shows the ordinary watercourses in the City Region.

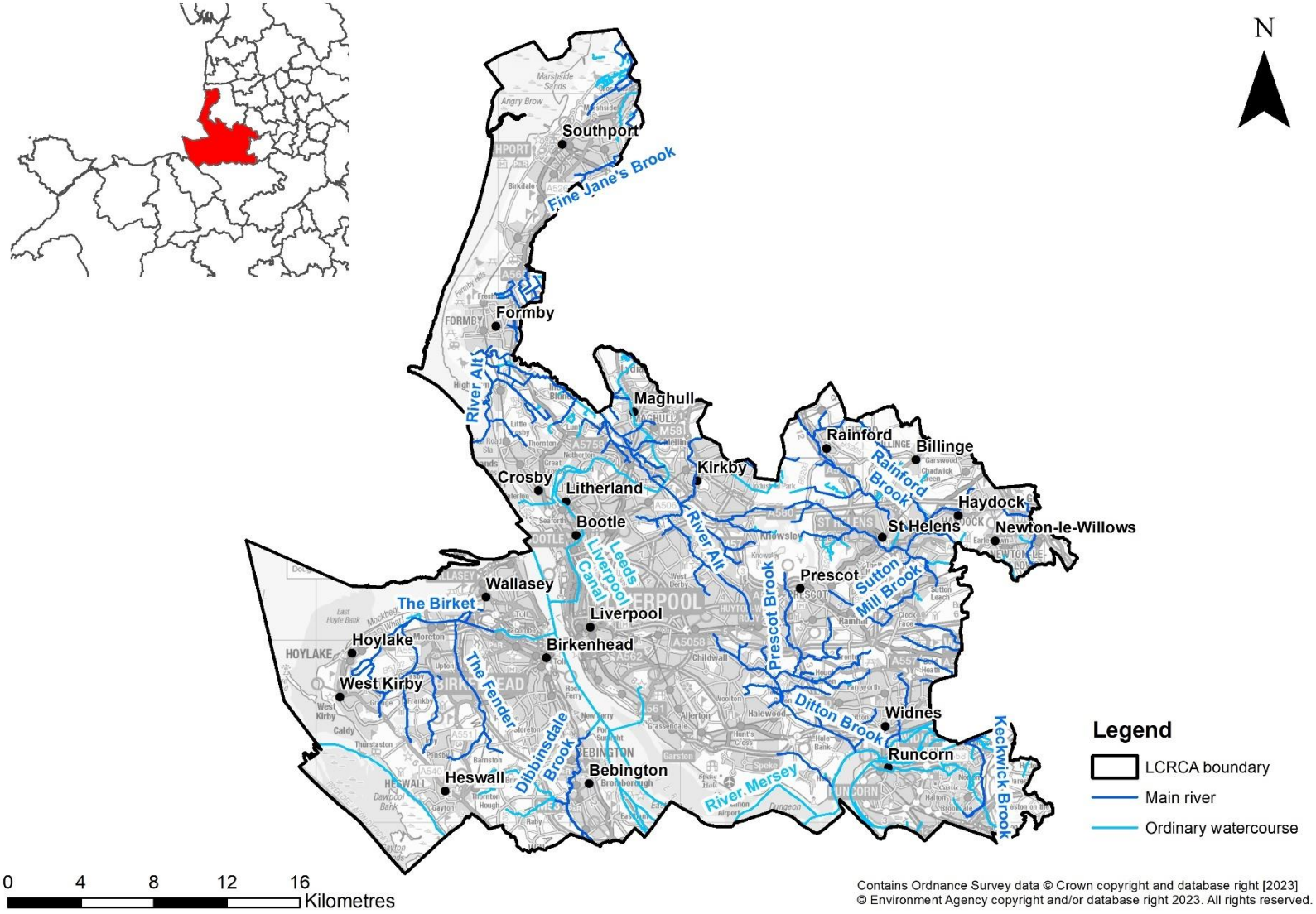

Figure 2-2: Main rivers and ordinary watercourses in the City Region

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. 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 (including vulnerable services such as hospitals and schools), commercial and industrial enterprises, agricultural land and environmental and cultural heritage. Flooding in the City Region can occur from many different and combined sources such as fluvial (from main rivers and ordinary watercourses), tidal (from the sea), surface water, groundwater, sewers or indirectly from infrastructure failure.

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.

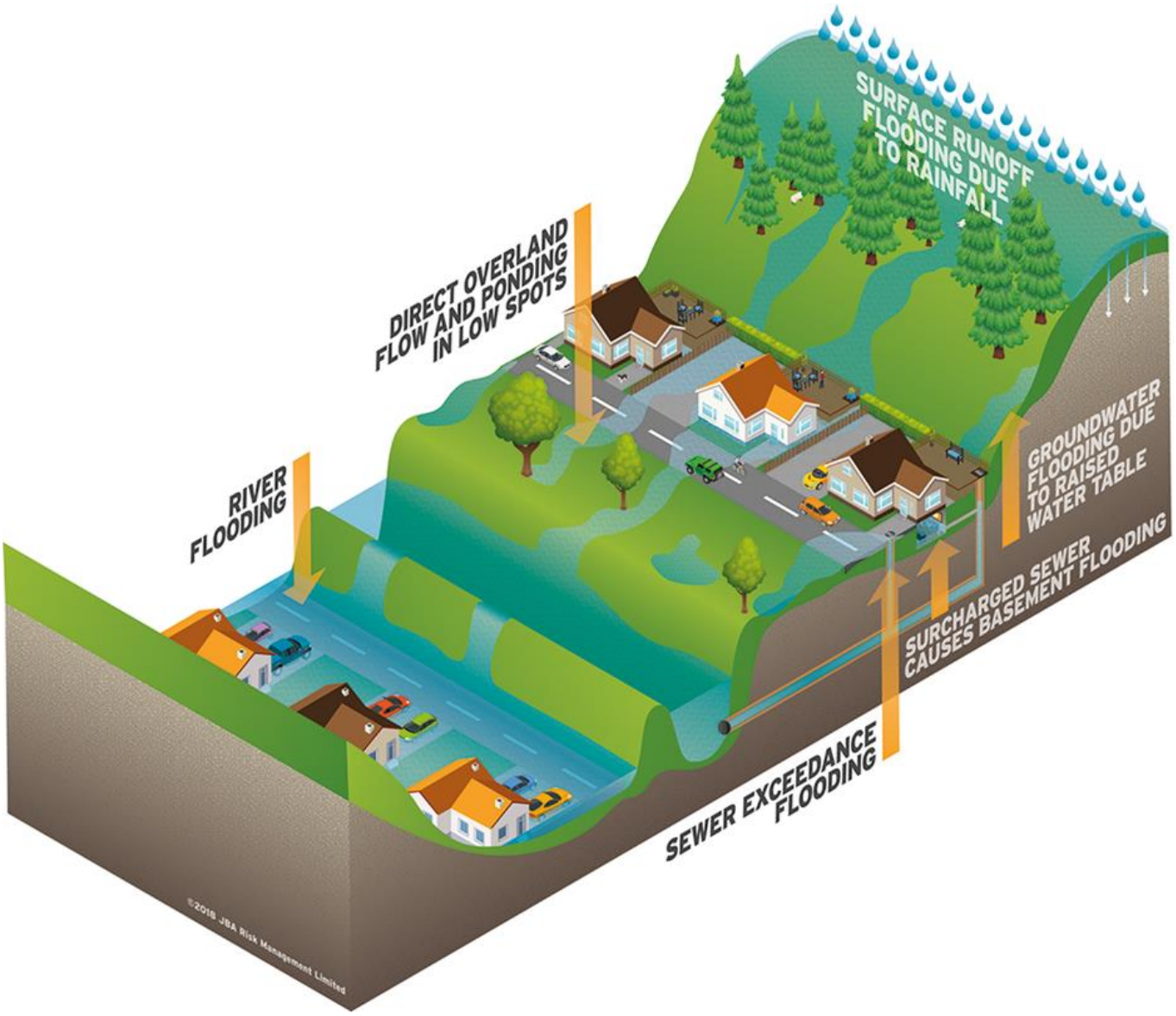

Figure 3-1: Flooding from all sources

3.1.1 Rivers

River flooding is the inundation of floodplains from rivers and watercourses; the inundation of areas outside the floodplain due to the influence of bridges, embankments and other features that artificially raise water levels; overtopping or breaching of defences; blockages of culverts or flood channels / corridors.

River flooding is associated with the exceedance of channel capacity during higher flows or as a result of blockage (residual risk). The process of flooding from a watercourse 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.

3.1.2 Tidal

Tidal flooding is caused in times of high astronomical tides and can also be caused by storm surge and wave action. Coastal regions and areas along tidal estuaries are at risk from tidal flooding.

The EAs' Flood Map for Planning (Rivers and Sea) (Section 4.2) is used to assess flood risk from main rivers and the sea in this SFRA. The Flood Map for Planning is presented on the SFRA Maps in Appendix B.

3.1.3 Surface water

Surface water or 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 lower areas or natural depressions. Areas at risk of pluvial flooding can, therefore, lie outside of the fluvial flood zones.

Pluvial flooding within the urban areas of the City Region will typically be associated with events equal to or greater than the 1 in 30 year (3.3% AEP) design standard of new sewer systems. Some older sewer and highway drainage networks will have a lower capacity than is required to mitigate for the 3.3% AEP event. There is also residual risk associated with these networks due to possible network failures, blockages or collapses.

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

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

The EA’s Risk of Flooding from Surface Water (RoFSW) map (Section 4.5) is used to assess surface water flood risk in this SFRA. Also, Section 5.7 provides guidance on SuDS options for developers. The RoFSW is presented on the SFRA Maps in Appendix B.

3.1.4 Groundwater

Groundwater water flooding occurs when the water table rises after prolonged rainfall to emerge above ground level remote from a watercourse. It is most likely to occur in low-lying areas underlain by permeable rock (aquifers) and groundwater recovery areas, after pumping for mining or industry has ceased. Warmer, wetter winters due to climate change may have significant impacts on groundwater levels.

Groundwater flooding is caused by the emergence of water from beneath the ground, either at point or diffuse locations. The occurrence of groundwater flooding is usually local and unlike flooding from rivers, does not generally pose a significant risk to life due to the slow rate at which the water level rises. However, groundwater flooding can cause significant damage to property, especially in urban areas and can pose further risks to the environment and ground stability.

There are several mechanisms that increase the risk of groundwater flooding including prolonged rainfall, high in-bank river levels, artificial structures, groundwater rebound and mine water rebound. Properties with basements or cellars or properties that are located within areas deemed to be susceptible to groundwater flooding are at particular risk. Development within areas that are susceptible to groundwater flooding will generally not be suited to infiltration SuDS; however, this is dependent on detailed site investigation and risk assessment at the FRA stage.

JBA's 5m Groundwater Flood Map (Section 4.6) is used to assess potential risk from groundwater in this SFRA and is presented on the SFRA Maps in Appendix B.

3.1.5 Sewers

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes blocked or it cannot discharge due to a high water level in the receiving watercourse. Pinch points and failures within the drainage network may also restrict flows. Water then begins to back up through the sewers and surcharge through manholes, potentially flooding highways and properties. It must be noted that sewer flooding in 'dry weather' resulting from blockage, collapse or pumping station mechanical failure (for example), is the sole concern of the drainage undertaker.

Combined sewers spread extensively across urban areas serving residential homes, business and highways, conveying waste and surface water to treatment works. Combined Sewer Overflows (CSOs) provide an EA consented overflow release from the drainage system into local watercourses or surface water systems during times of high flows. Some areas may also be served by separate waste and surface water sewers which convey wastewater to treatment works and surface water into local watercourses or combined sewers.

United Utilities (UU) is the water company responsible for the management of the public sewer drainage network across the City Region.

3.1.6 Reservoirs

A reservoir can usually be described as an artificial or non-natural lake where water is stored for use. The risk of flooding associated with reservoirs is residual (Section 4.9) and is associated with failure of reservoir outfalls or dam breaching. This risk is reduced through regular inspection and maintenance by the reservoir owner / undertaker or 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's Reservoir Flood Map (RFM) shows the locations at risk from reservoir flooding (Section 4.9.1).

3.1.7 Canals

The risk of flooding from a canal is 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 3-1. Canals can also have a significant interaction with other sources, such as watercourses that feed them and minor watercourses or drains that cross underneath. Section 4.10 discusses the potential risks from canals in the City Region.

Table 3-1 Canal flooding

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

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 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.

The principal flood sources in the City Region include fluvial, tidal and surface water; the most common pathways are rivers, drains, sewers, overland flows; and the receptors include people, their property and the environment. All three elements must be present for flood risk to arise. Mitigation, i.e. flood defence, measures have little or no effect on sources of flooding, but they can block or impede pathways or remove receptors.

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% AEP (Annual Exceedance Probability) event 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 (1%) chance of occurring in any one year, not that it will occur once every one hundred years. Table 3-2 provides an example of the flood probabilities used to describe the flood zones as defined in the FRCC-PPG and as used by the EA in its Flood Map for Planning (Rivers and Sea).

NOTE: Paragraph 078 of the FRCC-PPG states: - *"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 online via: Flood map for planning

Table 3-2 NPPF flood zones[12]

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 0.1% annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map for Planning – all land outside Zones 2, 3a and 3b)
Zone 2 Medium Probability	Land having between a 1% and 0.1% annual probability of river flooding; or land having between a 0.5% and 0.1% annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1% or greater annual probability of river flooding; or Land having a 0.5% or greater annual probability of sea. (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. LPAs should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the EA. (Not separately distinguished from Zone 3a on the Flood Map for Planning)

3.2.2 Consequence

The consequences of flooding include fatalities, property damage, disruption to lives and businesses, with severe implications for people (e.g. financial loss, emotional distress, health problems). Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow, rate of onset, duration, 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

3.2.3 Risk

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

12 Table 1: Flood Zones, Paragraph 001 of the Flood Risk and Coastal Change Planning Practice Guidance, August 2022

3.2.3.1 Existing risk

This is the risk 'as is' considering 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.

Existing 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 existing 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.

3.2.3.2 Residual risk

Defended areas remain at residual risk as there is a risk of defence failure during significant flood events. 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.

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 considered. 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 from flood risk management infrastructure affects large areas, the Strategic Flood Risk Assessment will need to indicate the nature, severity and variation in risk within this area, 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 strategic policies their preferred mitigation strategy for ensuring development will be safe throughout its lifetime in relation to urban form, risk management and where flood mitigation measures are likely to have wider sustainable design implications".

Residual flood risk from breach or overtopping of defences must be managed for any new development. 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.

3.3 Climate change

Following on from the UK Climate Projections 2009 (UKCP09), the UK Climate Projections 2018 (UKCP18) delivered a major upgrade to the range of UK climate projection tools designed to help decision-makers assess their risk exposure to our changing climate.

The UKCP18 project used cutting-edge climate science to provide updated observations and climate change projections up to the year 2100 across the UK. The project builds upon UKCP09 to provide the most up-to-date assessment of how the climate of the UK may change over the 21st century.

UKCP18 updates the projections over land and provides a set of detailed future climate projections for the UK at a 12km scale. Models of high impact events such as from localised heavy rainfall in the summer months were created. UKCP18 enables the UK to adapt to the challenges and opportunities presented by climate change.

In relation to flood risk and climate change in the planning system, the NPPF 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).

The Liverpool City Region Spatial Development Strategy along with the constituent authorities' 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.

The likely impacts of climate change are well documented and will have a significant impact on flood risk across the City Region. Increases in duration and intensity of extreme rainfall events as a result of climate change will increase flood risk from multiple sources. Section 4.12 details the EA's climate change allowances and how these have been applied in this SFRA.

4 Understanding flood risk across the Liverpool City Region

4.1 Flood risk datasets

This section of the SFRA provides a strategic overview of flood risk from all sources within the LCRCA area. The information contained is the best available at the time of publication and is intended to provide an overview of risk. Table 4-1 provides a summary of the key spatial datasets used in this regional SFRA according to the source of flooding.

Table 4-1: Flood source and key spatial datasets

Flood source	Datasets
Fluvial and tidal	EA Flood Map for Planning (Rivers and Sea) (downloaded April 2023)
	Latest available EA hydraulic flood models and outputs
	Modelled climate change outlines based on the latest EA allowances (modelled April / May 2023)
	Functional floodplain extent (updated May 2023)
	Shoreline Management Plan (SMP) policy mapping (downloaded May 2023)
	EA Risk of Flooding from Rivers and Sea map (downloaded April 2023)
	EA Flood Alert Areas (FAA) (downloaded April 2023)
	EA Flood Warning Areas (FWA) (downloaded April 2023)
Pluvial (surface water runoff)	EA Risk of Flooding from Surface Water (RoFSW) (downloaded April 2023)
	Modelled surface water climate change outlines based on RoFSW map (modelled March / April 2023)
	EA Flood Risk Areas (as defined in Preliminary Flood Risk Assessments) (downloaded May 2023)
Sewer	United Utilities Hydraulic Incidents (provided August 2022)
Groundwater	JBA 5m Groundwater Flood Map (May 2022)
Reservoir	EA Reservoir Flood Map (Dry Day) (downloaded May 2023)
Canal	Overtopping and Breach Archive (April 2022)
All sources	EA Historic Flood Map (HFM) (downloaded April 2023)
	EA Recorded Flood Outlines (RFO) (downloaded April 2023)
	Halton Flood Incident Database (2019)
	Wirral Flood Incident Database (2020)

Flood source	Datasets
	Liverpool Highways Flood Incident Database (2017)
	Halton Flood Incident Database (2022)
Flood risk management infrastructure	EA Spatial Flood Defence data (downloaded April 2023)
	EA Flood Storage Areas (FSA) (downloaded April 2023)

4.2 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 modelling reports which provide further detail on flooding mechanisms.

The Flood Map for Planning provides flood extents for:

- The 1 in 100 year (1% AEP) fluvial event and 1 in 200 year (0.5% AEP) tidal event (Flood Zone 3) and
- The 1 in 1000 AEP fluvial and tidal 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 do not consider sources of flooding other than from rivers and the sea and do not take account of 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 4.3).

This SFRA uses the Flood Map for Planning version downloaded in April 2023 to assess the risk from river and sea flooding. The Flood Map for Planning is updated 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 April 2023: Flood Map for Planning

Figure 4-1 shows the Flood Map for Planning at the LCRCA scale and Figure 4-2 shows the flood source of Flood Zone 3 i.e. fluvial, tidal or fluvial and tidal. Refer to the SFRA Maps in Appendix B to view the flood zones at a larger (more detailed) scale.

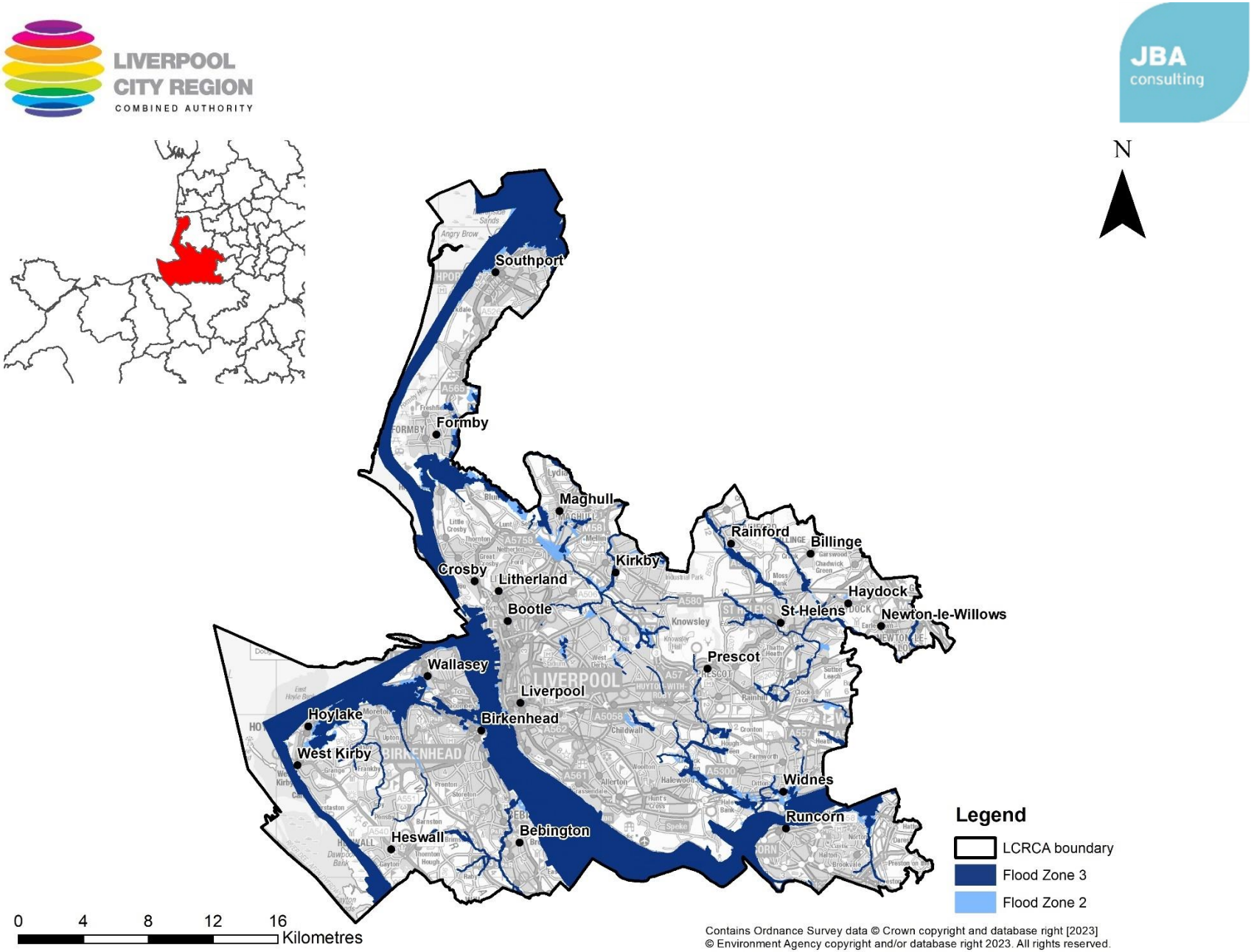

Figure 4-1: EA Flood Map for Planning

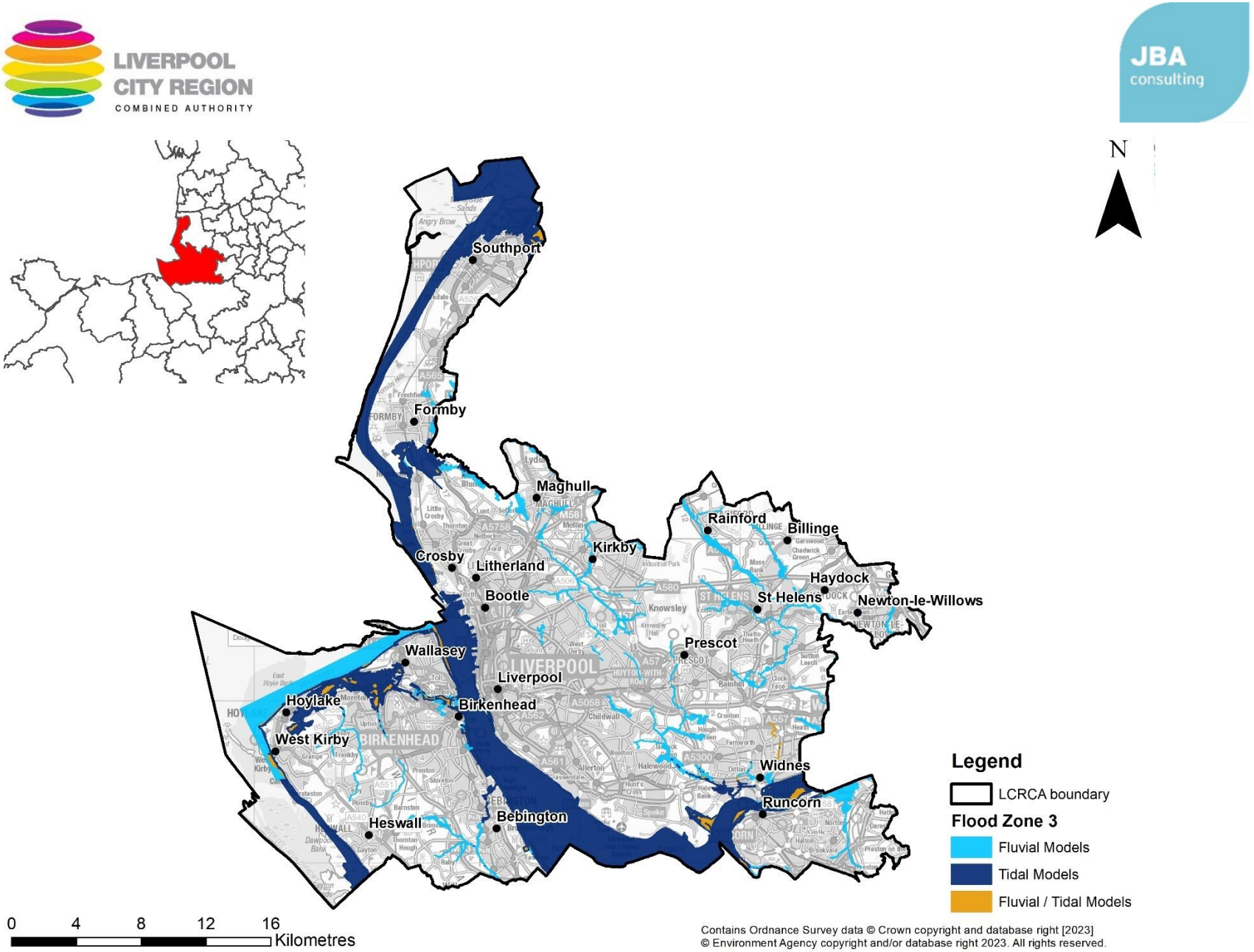

Figure 4-2: Flood Zone 3 fluvial and tidal flood risk

4.3 Functional floodplain (Flood Zone 3b)

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

The update to the FRCC-PPG in August 2022 changed the definition of the functional floodplain (Flood Zone 3b) from a 5% AEP event to a 3.3% AEP event.

Table 1, Paragraph 078 of the FRCC-PPG defines Flood Zone 3b as:

"…*land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise:*

- *land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or*
- *land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding)".*

Paragraph 078 also explains that:

"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."

As part of this regional SFRA, all available EA river and coastal models and outputs were supplied for use in the SFRA. A number of these models have been updated to produce the 3.3% AEP event defended scenario outline to update the functional floodplain. Additionally, the EA's Flood Storage Areas (FSA) dataset was used to represent land designed to flood.

As advised in the EA's SFRA guidance, the possible effects of climate change on the future functional floodplain should be assessed. These effects have been modelled where possible using the EA's latest allowances detailed in Section 4.12.

The future functional floodplain is based on the 3.3% AEP + higher central climate change uplift allowance. Where this wasn't available, the 4% AEP + higher central or the 5% AEP + higher central climate change modelled outlines were used. The uplift value refers to the percentage increase in flow applied to the modelled baseline river flows to reflect the impact of climate change. See the functional floodplain technical note in Appendix C and the modelling technical note in Appendix D for more detailed explanations of the climate change uplifts applied.

The functional floodplain and future functional floodplain outlines are assessed and agreed upon by the LCRCA, the LLFA and the EA, based on their local knowledge.

4.4 EA Risk of Flooding from Rivers and Sea map

The 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 interactive maps. The RoFRS map splits the likelihood of flooding into four risk categories:

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

The RoFRS map is included on the SFRA Maps in Appendix B to act as a supplementary piece of information and is not suitable for use with any planning application, nor should it be used for the sequential testing of sites. The EA's Flood Map for Planning should be used for all planning purposes, as per the FRCC-PPG.

4.5 Risk of Flooding from Surface Water dataset

The EA's SFRA guidance[9] states the SFRA maps should show the EA's long term flood risk maps, which includes the Risk of Flooding from Surface Water (RoFSW). The RoFSW is included on the SFRA Maps in Appendix B and illustrates the surface water flood risk at a high level across the region. Information within the constituent authorities' LFRMSs (Appendix A) provide more detailed information on local surface water risk including for various mitigative measures, i.e. SuDS. Section 5.7 of this report provides guidance on mitigation options and SuDS for developers.

The RoFSW 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 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.

NOTE: EA guidance on the use of the RoFSW states: *"This dataset is not suitable for identifying whether an individual property will flood. It should not be used with basemapping more detailed than 1:10,000 as the data is open to misinterpretation if used as a more detailed scale. Because of the way the map has been produced and the fact that it is indicative, the map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence."*

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

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

The EA produced a guidance document[13], updated in April 2019, explaining the methodology applied in producing the map.

The effects of climate change on the RoFSW dataset have been modelled as part of this SFRA using the EA's peak rainfall intensity allowances shown in Section 4.12.1.3.

Note: The national map of surface water flood risk is, at the time of writing, undergoing a significant update. However, the updated map is unlikely to made available until late-2024.

4.5.1 Locally agreed surface water information

EA guidance, from within the Flood and Water Management Act 2010 (FWMA), on using surface water flood risk information recommends that LLFA's, 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".

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.

The locally agreed surface water information for each constituent authority, where available, is outlined below:

- Halton Council's SWMP indicates 2D hydraulic modelling was undertaken for the local authority area, and flood maps for depth, hazard and velocity have been produced. In addition, a local suite of flood maps were produced as part of the Halton PFRA.
- Knowsley Council have adopted the RoFSW as being representative of their locally agreed surface water information.
- Liverpool City Council have adopted the RoFSW along with mapped polygons of historic surface water flooding as their locally agreed surface water information.
- Sefton Council have undertaken direct rainfall modelling to simulate surface water flooding in some parts of the study area to inform their SWMP.
- St Helens Council have adopted the RoFSW as being representative of their locally agreed surface water information.

13 What is the Risk of Flooding from Surface Water map? EA, 2019

- Wirral Council have compared their historic flooding information with the RoFSW and have agreed it is consistent and have adopted the dataset as their locally agreed surface water information.

4.6 Surface water Flood Risk Areas

The Liverpool and Sefton Preliminary Flood Risk Assessments (PFRAs), produced by the Liverpool City Council and Sefton Council LLFAs, identified surface water Flood Risk Areas for Liverpool, Formby and Southport. Surface water Flood Risk Areas show locations where there is believed to be significant surface water flood risk. Appendix A details these Flood Risk Areas.

4.7 Groundwater Flood Map

This SFRA assesses groundwater flood risk through JBA's 5m Groundwater Flood Map, which provides a general broadscale assessment of the groundwater flood hazard. The good practice guide to producing SFRAs[10], developed by the EA and published December 2021, recommends the use of this dataset in SFRAs. The map is categorised by grid codes where each code is explained in Table 4-2.

Table 4-2: Groundwater flood hazard classification of JBA 5m Groundwater Flood Map

Groundwater head difference (m)*	Grid Code	Class label
0 to 0.025	4	Groundwater levels are either very near (within 0.025m of), or at the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	3	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	2	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event. There is a risk of flooding to subsurface assets but surface manifestation of groundwater is unlikely.

Groundwater head difference (m)*	Grid Code	Class label
>5	1	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	0	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.		

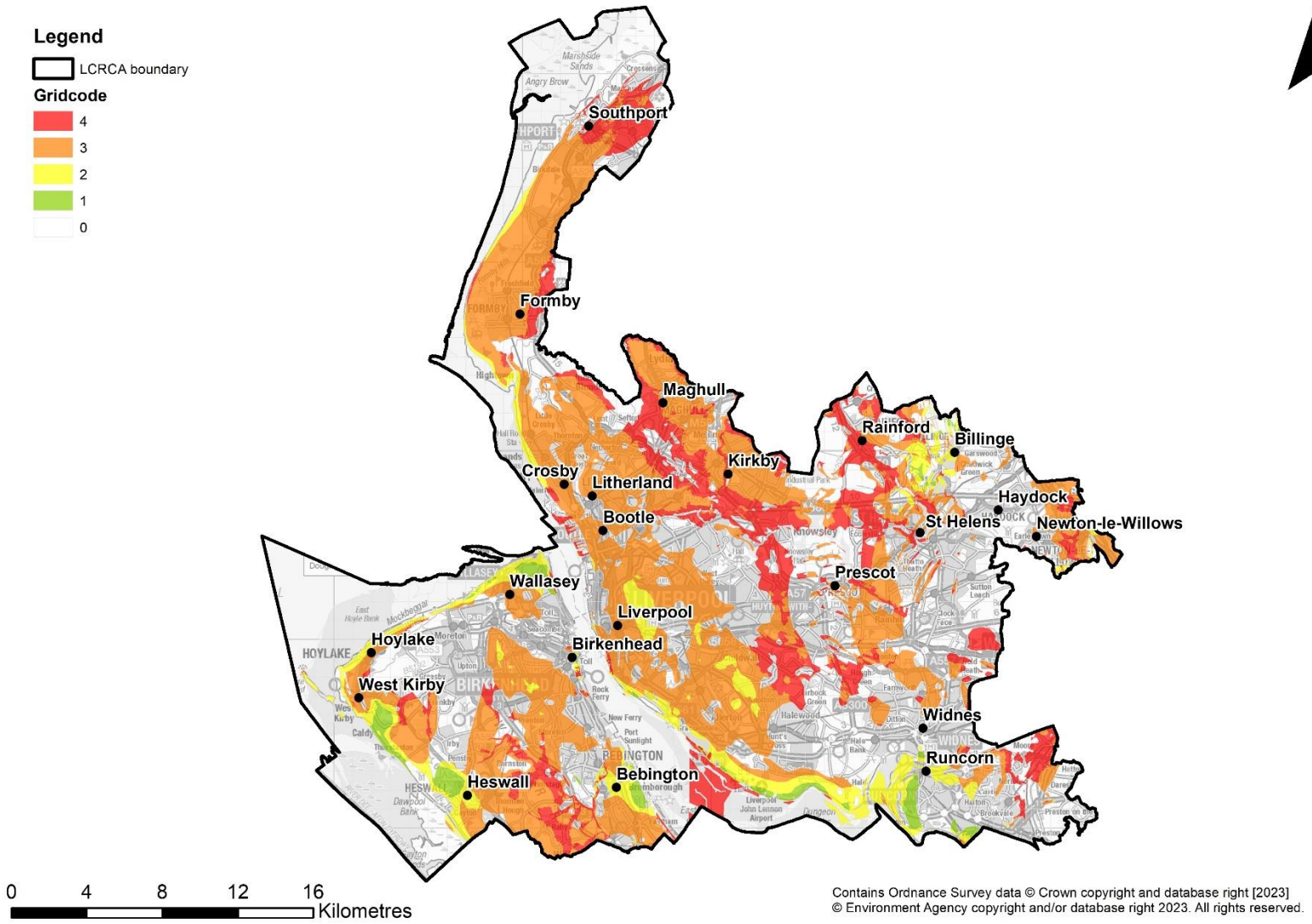

Figure 4-3: Groundwater flood risk - JBA 5m Groundwater Flood Map

Figure 4-3 shows the groundwater flood risk across the City Region. Please refer to Table 4-2 for grid code definitions. Due to the relatively low-lying topography of the Liverpool City Region, large areas of land are at risk of groundwater emerging at the ground surface and flooding surface assets (grid codes 3 and 4). The majority of Sefton, particularly Crossens, Marshside, Maghull and Aintree are at risk. Other notable locations at higher risk include Netherley and Belle Vale in Liverpool; Stockbridge Village and Huyton in Knowsley; St Helens town centre, Rainford and Newton le Willows in St Helens; Clatterbridge Hospital and Woodchurch in Wirral.

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

Groundwater flood risk should be considered particularly when determining the acceptability of SuDS schemes as a way of managing surface water drainage. Developers should consult with the LLFA and the EA at an early stage of any site-specific groundwater assessment. The JBA 5m Groundwater Flood Map is shown on the SFRA Maps in Appendix B.

4.8 Flood risk from sewers

As discussed in Section 3.1.5, United Utilities (UU) is the water company responsible for the management of the public sewer drainage network across the City Region. UU holds a historic sewer flood event database which is updated as and when a sewer flood event occurs. As this is a historic event dataset, please refer to Section 4.13.2.

4.9 Reservoirs

The EA is the enforcement authority for the Reservoirs Act 1975 in England and Wales, with the FWMA amending this Act. All large reservoirs must be regularly inspected and supervised by reservoir panel engineers. Local authorities are responsible for coordinating emergency plans for reservoir flooding and ensuring communities are well prepared. The LCRCA should work with other members of the Merseyside and Cheshire Resilience Forums to develop these plans. See Section 5.9.1.1 for more information on the Merseyside and Cheshire Resilience Forums.

Paragraph 046 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 dam failure, compared to other risks, when considering development downstream of a reservoir. Local planning authorities are also advised to consult with the owners/operators of raised reservoirs, to establish constraints upon safe development."

4.9.1 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 November 2021, the EA produced the RFM guidance 'Reservoir flood maps: when and how to use them'[14], which provides information on how the maps were produced and what they contain.

To view the RFM, the Defra Data Services Platform can be used to search for specific reservoirs at:

Reservoir Flood Maps

The RFM shows that there are 32 large-raised reservoirs which have the potential to impact the Liverpool City Region in the event of a breach. Figure 4-4 highlights the Risk of Flooding from Reservoirs extents across the Liverpool City Region. 20 of these large-raised reservoirs are located within the Liverpool City Region boundary:

- Alexandra Business Park
- Crosshill 1
- Kensington No.3
- Pex Hill No.2
- Prescot No.3
- Sutton Mill
- White Man's Dam
- Brown Edge No.3
- Crosshill 2
- Mizzy Dam
- Pex Hill No.3
- Prescot No.4
- Taylor Park Big Dam
- Willow Park Lake
- Carr Mill
- Eccleston Mere
- Montrey Reservoir
- Prescot No. 5
- Sefton Park Lake
- Wharford Farm Balancing Lake

14 Reservoir flood maps: when and how to use them – Environment Agency, 2021

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 LCRCA and the constituent LPAs 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 LCRCA and LPAs would 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 location within and/or whether emergency draw-down of the reservoir will add to the extent of flooding; and
- Emergency planning requirements with appropriate officers to ensure safe sustainable development.

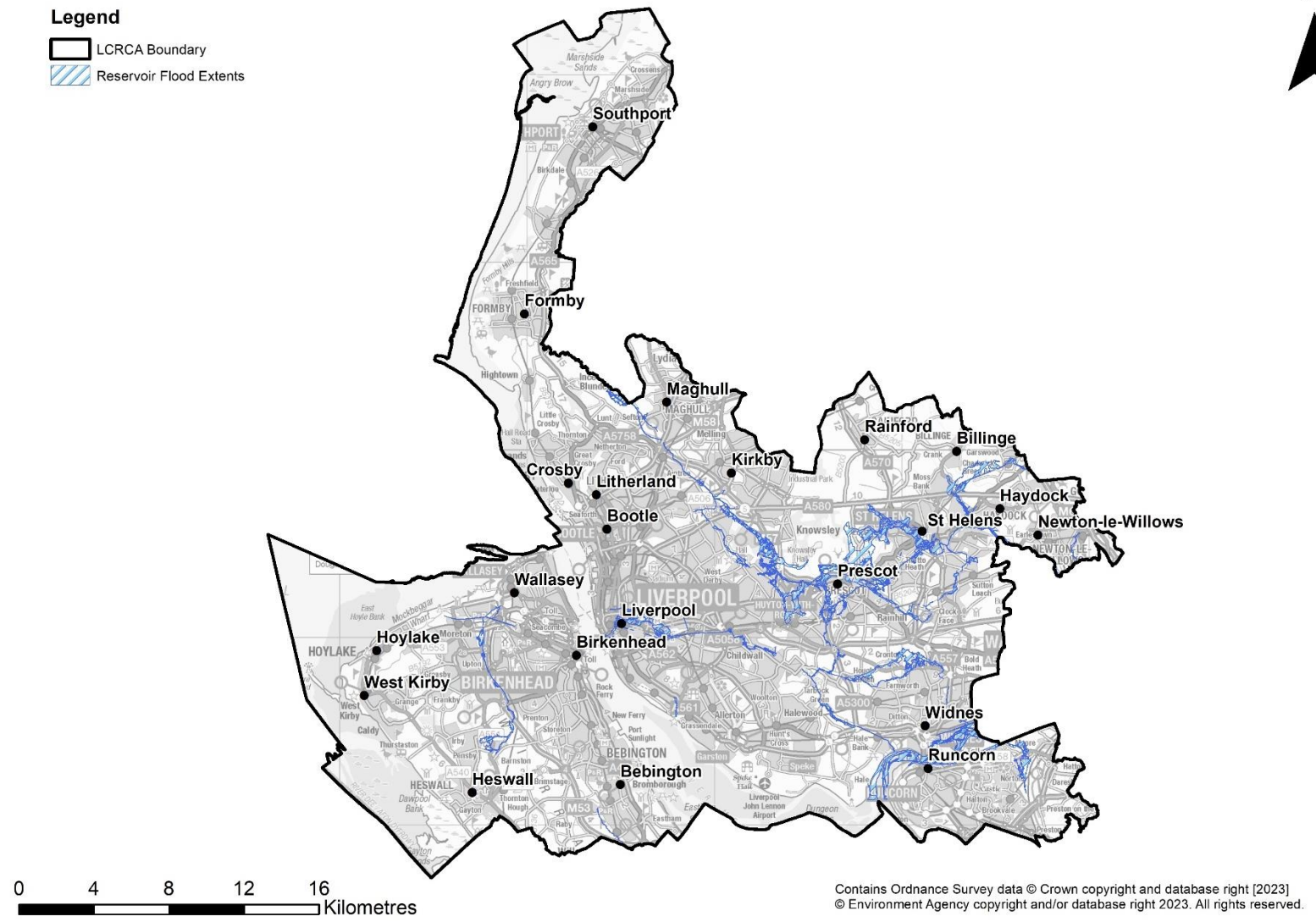

Figure 4-4: Risk of flooding from reservoirs within the Liverpool City Region

4.10 Flood risk from canals

The risks associated with flooding from canals are dependent on the 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.

There are four canals located within the Liverpool City Region:

- The Leeds and Liverpool Canal enters the combined authority area from the north through Sefton and continues south into Liverpool. It contains a considerable volume of water and therefore has the potential to cause severe flooding in the unlikely event of an embankment failure through any structural weakness. In June 2018, the Leeds and Liverpool Canal suffered a breach at Melling where a river channel is culverted beneath the canal. The breach flooded a number of properties situated nearby. The Canal & River Trust has indicated that there are some raised sections of canals within the Liverpool City Region, notably at Maghull (337186, 403235), the Alt Aqueduct (339288, 398903) and Brasenose Road (334110, 393989).
- The Manchester Ship Canal is a 36-mile long canal that links Manchester to the Irish Sea. It enters the City Region at Halton and reaches the Irish Sea within Wirral District.
- The Bridgewater Canal enters the City Region at Halton, with the canal ending at Runcorn. There have been no recorded breaches along the canal within Halton.
- The Sankey (St Helens) canal is located within St Helens district and is a former industrial canal. It remains navigable and is currently used for moorings. There are no raised sections along this canal.

At present, canals do not have a level of service for flood recurrence (i.e. there is no requirement for canals to be used in flood mitigation), although the Canal & River Trust, as part of its function, will endeavour to maintain water levels to control the risk of flooding from canals to adjacent properties. However, it is important that any development proposed adjacent to a canal be investigated on an individual basis regarding flooding issues and should be considered as part of any FRA.

4.11 Cumulative impacts

The NPPF 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 Town and Country Planning (Development Management Procedure) Order (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 development,
- Cross boundary impacts i.e. there should be dialogue between the LCRCA and neighbouring authorities (West Lancashire District, Wigan District, Warrington, Flintshire, and Cheshire West and Chester) on flood risk management practices and development,
- Leaving space for floodwater by safeguarding land through the SDS and utilising greenspace for flood storage and slowing the flow (see Sections 4.11.2 and 4.14.4),
- Ensuring floodplain connectivity, and
- SuDS and containment of surface water onsite as opposed to directing elsewhere (Section 5.7).

When identifying strategic sites for the SDS, 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 SDS, the LCRCA 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,
- 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 the City Region,

- 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 the City Region,
- 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 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 strategic development decisions 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.

The need for consistent regional development policies controlling runoff or development in floodplains within contributing districts is crucial as this would have wider benefits for neighbouring local authorities as well as the LCRCA. This should be carried out by the successful implementation of the sequential test.

According to the NPPF, planning authorities 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. The LCRCA is represented by the North-West Regional Flood and Coastal Committee (RFCC) where cross-boundary resources, projects and data are shared.

4.11.1 Hydrological linkages and cross boundary issues

Figure 4-5 illustrates fluvial hydraulic linkages for the catchments in and around the City Region. The majority of main rivers within the Liverpool City Region originate within the combined authority area, therefore development in neighbouring authorities is unlikely to significantly impact flood risk within the LCRCA. However, the River Mersey enters the City Region from Warrington, therefore major land use changes within Warrington may impact on flow regimes and flood risk.

A number of watercourses that originate from within the City Region enter into neighbouring catchments and cross local authority boundaries, i.e. Newton Brook and Sankey Brook flow into Warrington from St Helens. Development control and responsible land management across the constituent authorities is crucial to ensuring sustainable development across the combined authority area. Close partnerships between the combined authority, constituent authorities, and the surrounding authorities will need to be maintained.

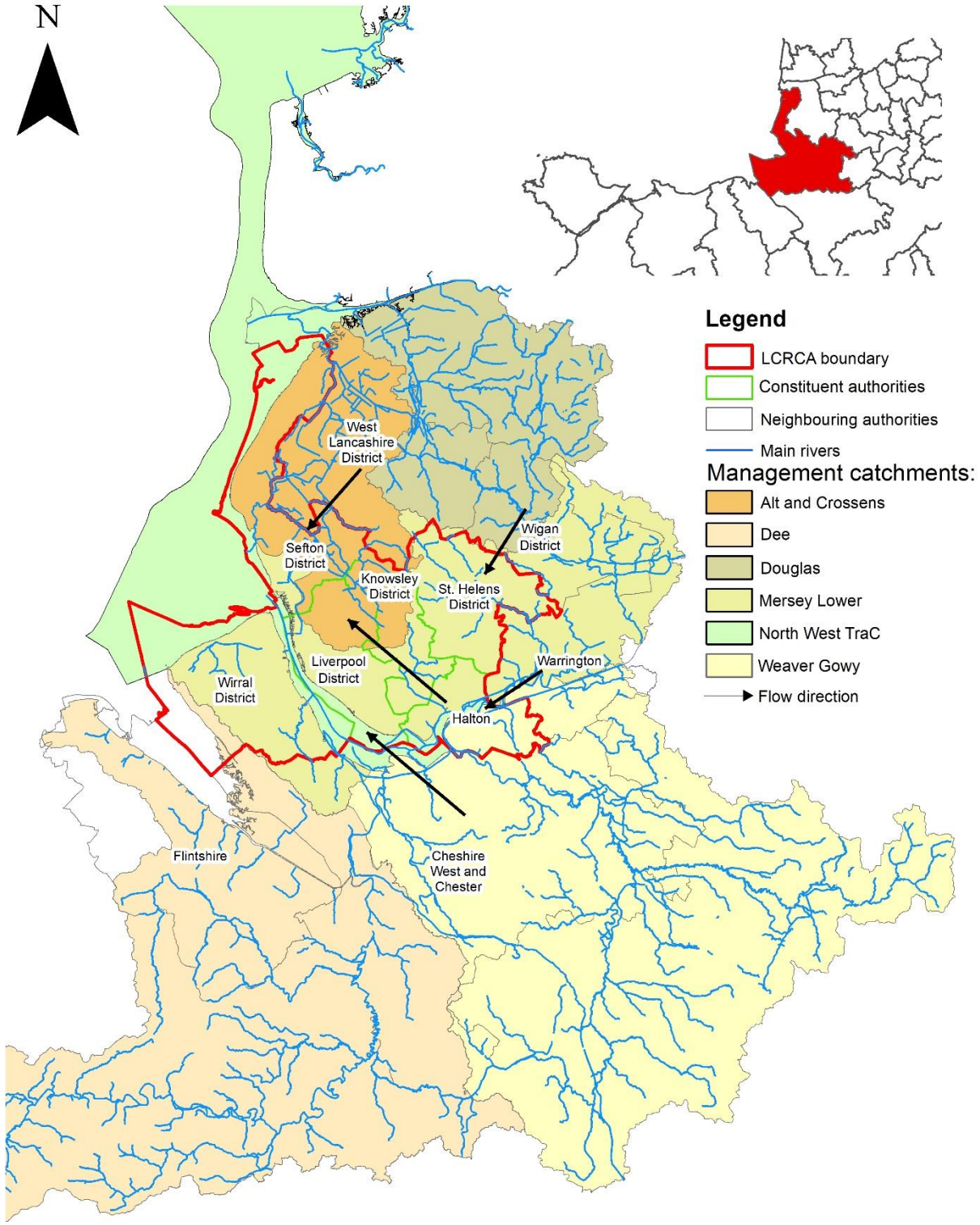

Figure 4-5: Hydrological linkages for catchments in and around the LCRCA

4.11.2 Safeguarding land for flood storage

Where possible, the LCRCA may look to identify land that could be reserved for flood storage functions. Such land uses can be explored through the local plan site allocation process and also at a high level through the SDS whereby an assessment is made, using this SFRA, of the flood risk at strategic sites and the potential benefits gained by leaving certain areas undeveloped. In some instances, the storage of floodwater 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 floodwater.

Paragraph 161 of the NPPF states:

to avoid where possible, flood risk to people and property, the LPAs 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 locations may include any current greenfield sites:

- That are considered to be large enough to store floodwater to achieve effective mitigation (modelling would be required),
- With large areas of their footprint at high or medium surface water flood risk (based on the RoFSW),
- 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 floodwater from a nearby development site using appropriate SuDS techniques which may involve pumping, piping or swales/drains.

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

4.12 Climate change

NPPF para 8 states that mitigating and adapting to climate change is an important objective that is key to delivering sustainable development that should be delivered through local plans.

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

"New development should be planned for in ways that:

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure". (Para 154).

This regional SFRA should be the starting point for the combined authority and the constituent authorities to assess the effects of climate change on flood risk across the

City Region. Section 4.12.2 details the climate change modelling carried out as part of this regional SFRA.

Along with the NPPF, FRCC-PPG and EA guidance, the combined authority and constituent authorities should refer to the Royal Town Planning Institute and Town & Country Planning Association's new edition of their joint guidance: 'The Climate Crisis – a guide for local authorities on planning for climate change[15]' when preparing the local plan.

4.12.1 EA climate change allowances

The EA previously revised the climate change allowances for sea level rise in December 2019, peak river flows in July 2021, and peak rainfall in May 2022, for use in FRAs and SFRAs and will, at the time of writing, use these revised allowances when providing advice. These updates are based on the release of UKCP18.

Climate change guidance is continually evolving therefore developers should refer to the climate change allowances on Government's website[16] to ensure those outlined below are the most up-to-date available.

Constituent LPAs may require developers to use specific climate change allowance categories. Refer to local guidance for further information.

4.12.1.1 Sea level allowances

Allowances for sea level rise are based on river basin district and were last updated in 2019. The allowances for the North West RBD are shown in Table 4-3. The number in brackets is the cumulative sea level rise for each year within each range. The EA expects SFRAs and FRAs to assess both allowance categories and also the H++ allowance in some cases. The H++ scenario for sea level rise for England is set at a total sea level rise of 1.9 metres, up to the year 2100.

Table 4-4 indicates the offshore wind and wave height allowances. Wave heights may change because of increased water depths or changes to the frequency, duration and severity of storms.

Table 4-3: Sea level allowances for the North-West RBD

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

15 The Climate Crisis – a guide for local authorities on planning for climate change | The Royal Town Planning Institute and Town & Country Planning Association | January 2023

16 Flood risk assessments: climate change allowances | Environment Agency | May 2022

Table 4-4: Offshore wind speed and extreme wave height allowance (based on a 1990 baseline)

Applies all around the English coast	2000 to 2055	2056 to 2125
Offshore wind speed allowance	5%	10%
Offshore wind speed sensitivity test	10%	10%
Extreme wave height allowance	5%	10%
Extreme wave heigh sensitivity test	10%	10%

4.12.1.2 Peak river flow allowances

Peak river flow allowances show the anticipated changes to peak flow by EA management catchment. Broadly, both the central and higher central allowances for the 2080s epoch are required to be assessed for SFRAs. Table 4-5 lists the allowances for each management catchment and Figure 4-6 shows the Lower Mersey, Alt and Crossens and the Weaver Gowy management catchments which cover the City Region. Management catchments are sub-catchments of river basin districts.

Table 4-5: Recommended peak river flow allowances for the Lower Mersey, Alt and Crossens and Weaver Gowy management catchments

Management catchment	Allowance category	Total potential change anticipated for peak river flows (based on a 1981 to 2000 baseline)		
		2020s (2015-2039)	2050s (2040-2069)	2080s (2070-2125)
Lower Mersey	Upper end	32%	55%	90%
	Higher central	22%	35%	57%
	Central	18%	27%	44%
Alt and Crossens	Upper end	31%	56%	95%
	Higher central	21%	33%	58%
	Central	16%	25%	44%
Weaver Gowy	Upper end	36%	64%	106%
	Higher central	24%	40%	67%
	Central	19%	30%	52%
Dee	Upper end	26%	32%	50%
	Higher central	16%	19%	30%

Management catchment	Allowance category	Total potential change anticipated for peak river flows (based on a 1981 to 2000 baseline)		
		2020s (2015-2039)	2050s (2040-2069)	2080s (2070-2125)
Lower Mersey	Upper end	32%	55%	90%
	Higher central	22%	35%	57%
	Central	18%	27%	44%
	Central	12%	14%	22%

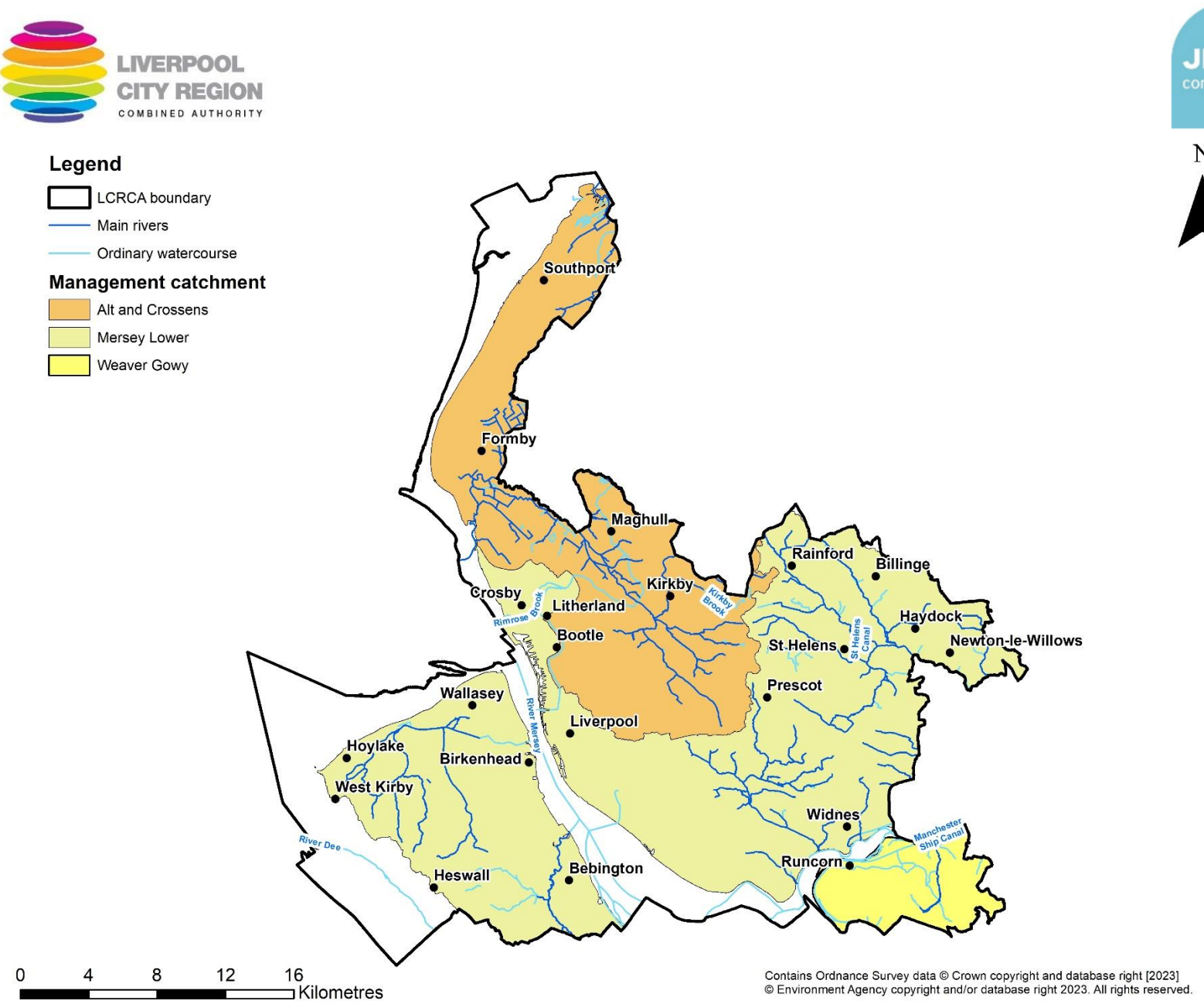

Figure 4-6: EA management catchments

4.12.1.3 Peak rainfall intensity allowances

To gauge the impacts of climate change on surface water and for small scale drainage design, the EA has produced allowances for peak rainfall intensities based on EA management catchments, provided in Table 4-6, which should be used for small (less than 5km^2) and urbanised drainage catchments. However, the peak river flow allowances (Table 4-5) should be used for any large rural drainage catchments.

The EA advises that SFRAs and FRAs should assess the upper end allowances to gauge the range of impacts.

Table 4-6: Peak rainfall intensity allowances in small and urban catchments for England

Management catchment	Allowance category	Total potential change anticipated for peak rainfall intensities (based on a 1961 to 1990 baseline)			
		3.3% annual exceedance rainfall event		1% annual exceedance rainfall event	
		2050s (up to 2060)	2070s (2061-2125)	2050s (up to 2060)	2070s (2061-2125)
Lower Mersey	Upper end	35%	40%	40%	45%
	Central	20%	30%	25%	30%
Alt and Crossens	Upper end	35%	40%	40%	45%
	Central	25%	30%	25%	30%
Weaver Gowy	Upper end	35%	40%	40%	45%
	Central	20%	25%	25%	30%
Dee	Upper end	35%	40%	40%	45%
	Central	20%	30%	25%	30%

4.12.2 Climate change modelling in the City Region

To represent the increased flood risk resulting from climate change on flooding from rivers and from the coast, peak river inflows and tidal boundaries were uplifted respectively according to the EA allowances listed in the tables above. The hydraulic models of the watercourses and coastal areas outlined in Table 4-7 were updated in accordance with the EA peak river flow allowances and sea level allowances (where applicable), to produce flood extents to support the SDS. These climate change flood extents are presented on the SFRA Maps in Appendix B.

Table 4-7 Modelled climate change allowances within LCRCA

Watercourse	Management catchment	Central allowance modelled	Higher central allowance modelled
Clipsley Brook	Lower Mersey	44%	57%
Firwood Grove	Lower Mersey	44%	57%

Watercourse	Management catchment	Central allowance modelled	Higher central allowance modelled
Upper Dibbinsdale Brook	Lower Mersey	44%	57%
Greasby Brook	Lower Mersey	44%	57%
Birket, Fender and Arrowe Brook	Lower Mersey	44%	57%
Logwood Mill Brook	Lower Mersey	44%	57%
Lower Dibbinsdale Brook	Lower Mersey	44%	57%
Mersey Estuary	Lower Mersey	44%	57%
Netherley and Halewood	Lower Mersey	44%	57%
Pendlebury Brook	Lower Mersey	44%	57%
Randle and Rainford	Lower Mersey	44%	57%
Stewards Brook	Lower Mersey	44%	57%
Wirral Tidal	Lower Mersey	44%	57%
Kirkby	Lower Mersey	44%	57%
Keckwick Brook	Lower Mersey	44%	57%
Murdishaw Brook	Lower Mersey	44%	57%
Upper Alt	Alt and Crossens	44%	58%
Crossens	Alt and Crossens	44%	58%
Lower Alt	Alt and Crossens	44%	58%
Knowsley	Alt and Crossens	44%	58%
Maghull	Alt and Crossens	44%	58%
Tidal Lancs	Alt and Crossens	44%	58%

The impact of climate change on surface water has been modelled based on the EA allowances for peak rainfall for the whole City Region. The SFRA Maps in Appendix B show the RoFSW plus climate change.

4.13 Historic flooding

Records of past flood events can help to build a picture of areas and locations that may be prone to flooding and to help back up or confirm flood modelling outputs. Historic flood events can also help Risk Management Authorities to target where flood risk management or resilience works may be required based on tangible evidence.

4.13.1 LLFA historic flood records

LLFA's are required, under the FWMA, to maintain and update a historic flood incidents database as and when any locally significant flood incidents occur. Strategic planning documents such as the Shoreline Management Plan, Coastal Strategies, Catchment Flood Management Plans, Preliminary Flood Risk Assessment and the constituent authority SFRAs contain much information on historic flood incidents.

4.13.2 UU historic flood records

UU keeps a record of flood incidents from its drainage and sewer networks. Many historic flooding incidents from sewers are at the individual property level and therefore considered sensitive information. The historic sewer flood incidents are therefore aggregated to ward level as shown in Figure 4-7.

The largest number of recorded sewer flooding incidents have occurred in Sefton around Aintree, south and east of Maghull, in Blundellsands, Brighton le Sands, Marshside, Churchtown, Formby and Ince Blundell; and also in Liverpool around West Derby.

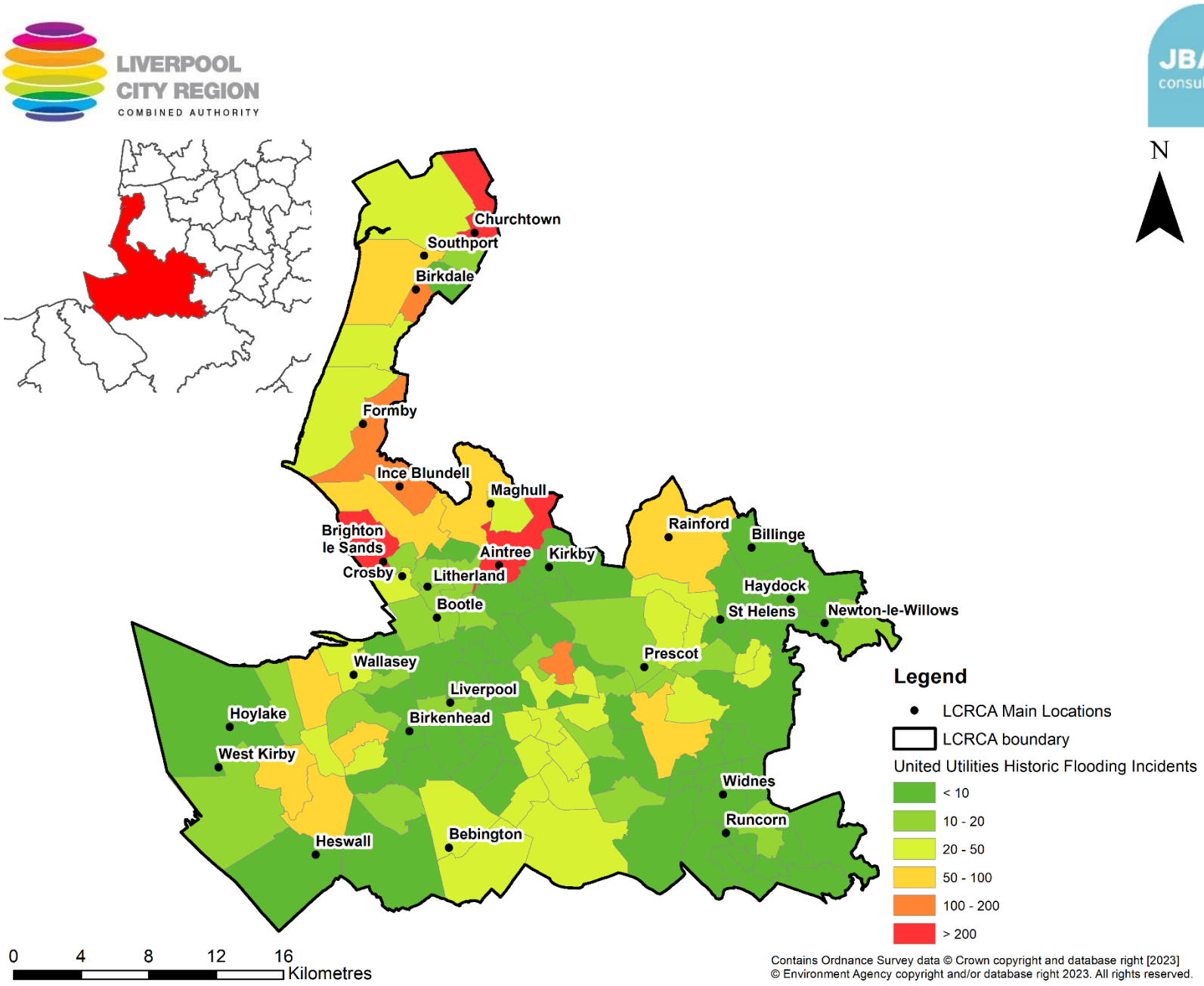

Figure 4-7: UU historic sewer flooding incidents per ward

4.13.3 Historic surface water flooding

Surface water flooding has been recorded to have previously occurred across the City Region, the locations of which are outlined below for each LPA:

- Halton – Kingsway and Appleton Wards in Widnes
- Knowsley – known flooding to some isolated properties Knowsley Village, Huyton, Prescot and Halewood
- Liverpool – Deysbrook and Tuebrook areas, and heavily urbanised areas such as Liverpool City Centre
- Sefton – Maghull, Formby, Thornton and Lydiate
- St Helens – Blackbrook, Eccleston, Rainford and the Town Centre
- Wirral – widespread historic surface water flood events across Wirral, many occurring due to culvert blockages.

The dates of the events are not known.

4.13.4 Historic groundwater flooding

It is difficult to attribute a groundwater flooding event as occurring solely due to groundwater as its source. It may be the case that groundwater flood events have occurred but have not been recorded. The known areas susceptible to groundwater flooding are indicated below:

- Liverpool – Liverpool and Sefton Flood Risk Area and coastal areas
- Sefton – Liverpool and Sefton Flood Risk Area and coastal areas
- St Helens – Billinge and Eccleston.

4.13.5 EA Historic Flood Map (HFM) and Recorded Flood Outlines (RFO)

The Historic Flood Map (HFM) is a spatial dataset 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.

In relation to the Liverpool City Region, the HFM and RFO show areas of historic flooding at Hale, Widnes, Leasowe, Wallasey and West Kirby. There is also an area of historic flooding along the rural floodplain of the River Alt at Homer Green.

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

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

4.14.1 EA inspected assets (Spatial Flood Defences)

The EA maintains 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.

This dataset does not include flood defence assets on non-main rivers. See Figure 4-8 for condition assessment grades using the EA’s Condition Assessment Manual[17] (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.

17 Environment Agency. (2012). Visual Inspection Condition Grades. In: EA Condition Assessment Manual. Bristol: Environment Agency. P9.

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.

Figure 4-8: EA flood defence condition assessment grades

Table 4-8: Major flood defences within the Liverpool City Region

Defence Location	Asset Type	Flood Source	Watercourse	Design Standard	Condition grade
The Birket (Wirral)	Wall (12) Embankment (30)	Fluvial/tidal	The Birket/tidal	N/A (1) 5 (1) 100 (40)	N/A (2) 2 (1) 3 (34) 4 (4) 5 (1)
Heswall (Wirral)	Embankment	Coastal	Coastal	200	3
River Alt (Liverpool)	Embankment (6)	Fluvial	River Alt	N/A (1) 50 (3) 100 (2)	N/A (6)
Runcorn (Halton)	Embankment (9) Wall (6)	Fluvial/tidal	River Weaver/tidal	N/A (15)	N/A (15)
Keckwick Brook (Halton)	Embankment (14) Wall (2)	Fluvial	Keckwick Brook	N/A (3) 50 (4) 100 (9)	N/A (4) 3 (9) 4 (3)
Hale (Halton)	Embankment (3)	Fluvial	Rams Brook	5 (3)	N/A (1) 3 (2)
Hale Bank (Halton)	Embankment (5) Wall (6)	Fluvial	Unnamed channel	5 (3) 100 (8)	N/A (2) 3 (5) 4 (2) 5 (2)

Defence Location	Asset Type	Flood Source	Watercourse	Design Standard	Condition grade
Eccleston (St Helens)	Embankment (8) Wall (19)	Fluvial	Windle Brook	N/A (3) 5 (1) 50 (23)	N/A (6) 1 (1) 2 (6) 3 (13) 4 (1)
Newton-le-Willows (St Helens)	Embankment (4) Wall (1)	Fluvial	Newton Brook/Ellams Brook	N/A (5)	N/A (5)
Sutton Leach (St Helens)	Embankment (4) Wall (2)	Fluvial	Sutton Mill Brook	N/A (6)	N/A (6)
Maghull and Lunt Meadows (Sefton)	Embankment (17)	Fluvial	Moor Hey Brook/Dover's Brook/Harrison's Brook	50 (17)	N/A (14) 3 (3)
Crosby (Sefton)	Embankment (1) Wall (1)	Coastal	Coastal	20 (2)	N/A (2)
Hightown (Sefton)	Embankment (10)	Tidal	River Alt	50 (10)	N/A (10)
Hough Green (Knowsley)	Embankment (8)	Fluvial/tidal	Ditton Brook	N/A (3) 100 (5)	N/A (3) 3 (3) 4 (2)
Tarbock Green (Knowsley)	Embankment (3)	Fluvial	Dog Clog Brook	100 (3)	3 (1) 4 (2)
Number in brackets = number of assets					

Table 4-8 highlights the main locations within the combined authority area that have significant FRM assets. These are located along watercourses and at the coast, across the LCRCA. Sefton district contains the largest number of significant FRM assets within the combined authority area. The Spatial Flood Defences dataset is shown on the SFRA Maps in Appendix B.

The condition rating of assets within the City Region range from 1 to 5, with the majority of them being assessed at condition grade 3 meaning the condition is rated as 'Fair' according to the EA's Condition Assessment Manual meaning that there are defects that could reduce performance of the structure. The design standard of protection of the assets within the City Region range from 5-years to 200-years.

There are areas of high ground along most of the main rivers within the City Region, offering protection from fluvial flooding, though with no formally engineered defences. The condition grade of the majority of these defences is stated as 3/4, which means 'Fair/Poor', meaning there could be defects that could reduce the performance of the asset or the defects are only minor and would not compromise performance, and that these could be significant.

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 unknowingly carry out work that may be detrimental to flood risk;
- Identifying and promoting new flood alleviation schemes (FAS), were 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; and
- Promoting resilience measures for existing properties that are currently at flood risk or may be in the future as a result of climate change (Property Flood Resilience - see Section 5.8.

4.14.2 LLFA assets and future Flood Risk Management Schemes

The LLFAs within the Liverpool City Region own and maintain a large number of assets which include culverts, bridge structures, gullies, weirs and trash screens. The majority of these assets lie along ordinary 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 landowners.

LLFAs, under the provisions of the FWMA, have 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. The Act places no duty on the LLFAs to maintain any third-party features, only those for which the authority has responsibility as land/asset owner. Flood risk asset data has not been provided for inclusion within this SFRA at the time of writing.

Current significant LLFA flood risk management schemes within the City Region include:

- West Kirby Flood Alleviation Scheme – construction of a flood wall set back from the promenade to protect around 600 properties that would be at risk when climate change up to 100 years is considered.
- Wallasey Embankment Toe Reinforcement Works - the extension of the existing rock armour toe protection by placing 7,000 tonnes of rock armour along 1,100m of unprotected toe to Wallasey Embankment.

4.14.3 Water company assets

The sewerage infrastructure of the City Region may have a risk of localised flooding associated with the existing drainage capacity and sewer system. UU is responsible for the management of the adopted sewerage system. This includes surface water and foul sewerage. There may however be some private surface water sewers in the region 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, 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.

4.14.4 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. 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.

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 floodwaters before they can damage flood risk receptors (e.g. people, property, infrastructure, etc.). WwNP involves taking action to manage flood and coastal erosion risk by protecting, restoring and emulating the natural regulating functions of catchments, rivers, floodplains and coasts.

The EA is actively encouraging the implementation of WwNP measures within catchments and coastal areas in order to assist in the delivery of environmental protection and national policies. The implementation of WwNP will continue to become a fundamental component of the flood risk management tool kit due to climate change.

4.14.4.1 Evidence base for WwNP to reduce flood risk

The EA has produced the WwNP evidence base which includes three interlinked projects:

- Evidence directory;
- Mapping the potential for WwNP; and
- Research gaps.

The evidence base can be accessed via: 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; and
- Where in a catchment they might not be most effective.

A guidance document sits alongside the evidence directory and the WwNP maps which explains how to use them to help make the case for implementing WwNP when developing business cases for flood risk management.

4.14.4.2 Mapping the potential for WwNP

National maps for England make use of different mapping datasets and highlight the 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 potential areas for WwNP however they do not account for issues such as land ownership and drainage infrastructure. However, they will help to 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 Figure 4-9.

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.

Figure 4-9: WwNP measures and data

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 (Section 4.4)

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.

- Runoff Attenuation Features (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; and
  - 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.

The key areas within the City Region that could be considered to have significant potential for WwNP schemes are:

- Sefton at Maghull (large scale tree planting here or elsewhere within Sefton may not be appropriate on landscape character or biodiversity grounds)
- North of St Helens
- Knowsley at Halewood

An interactive map of nature-based flood risk management projects and potential projects can be found at: JBA Trust Mapping

4.14.5 EA flood risk management activities and Flood and Coastal Erosion Risk Management (FCERM) 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 strategic objectives for research include:

- better understand future flood and coastal erosion risk
- prepare for the scale and frequency of future incidents
- optimise the management of FCERM infrastructure
- improve responsibility and funding for flood and coastal risk
- understand the potential of new technology and innovation
- increase resilience to flood and coastal erosion risk.

Completed and ongoing research can be researched online via: FCERM research and development projects

Based on information provided by the EA at the time of writing, the current EA flood risk management work programmes are visible in Figure 4-10.

ID	Project
0	Black Brook Culvert Refurbishment
1	River Mersey Wall, Dingle and Beechwood Road
2	Pipeline Priority: Ditton Brook - Halebank (inc Asset Replacement)
3	Bridgeway and Lockgate, Runcorn
4	Clifton Road, Runcorn Culvert Rehabilitation
5	Dorchester Park_Malmesbury Park, Runcorn
6	Liverpool Road, Widnes Culvert Rehabilitation
7	Marling Park, Widnes
8	Pitville Terrace, Widnes FAS
9	Runcorn & Widnes Culvert Study
10	Runcorn Road, Moore, Runcorn Culvert Rehabilitation
11	Pipeline Priority: Birket and Fender
12	Pipeline Priority: Ditton Brook - Halewood (inc Asset Replacement)
13	Knowsley Debris Screen Health and Safety Improvements
14	Knowsley MBC - Ordinary Watercourse Network
15	Knowsley MBC SWMP
16	Knowsley Village Land Drainage Investigation
17	Salerno Drive, Knowsley
18	Warrington Road, Knowsley: Culvert Remedial Works
19	Whiston Lane Flood Alleviation Scheme
20	Forty Pitts Drain (possible collapse)
21	Liverpool Debris screens and access (various locations)
22	Lower Tuebrook culvert, Liverpool (combined scheme)
23	Mab Lane partial culvert relining / replacement
24	Stanfordham Drain (Culvert Investigation)
25	Upper Brook Culvert relining (rear of 8 Rose Court)
26	Upper Tuebrook, Worcester Drive (Emergency Works)
27	Ainsdale and Birkdale, Southport
28	Crosby Marine Lake to Formby Point Strategy Delivery Prog
29	Four Acres, Maghull Asset Management Plan
30	The Pool, Southport
31	Willow Hey, Maghull, NMR Improvements
32	Arrowe Road & Rigby Drive Greasby Flood Relief
33	Coronation Park Greasby Flood Relief
34	Meols Parade Coast Protection, Wirral
35	Wallasey Embankment, Wirral
36	West Kirby FAS
37	Wirral Surface Water Mgmt Scheme
38	Heswall Flood Relief SoP100
39	Pensby
40	West End Road St Helens
41	Liverpool Culvert Review and Refurbuishment Package
42	Warrington Rd Culvert Investigation

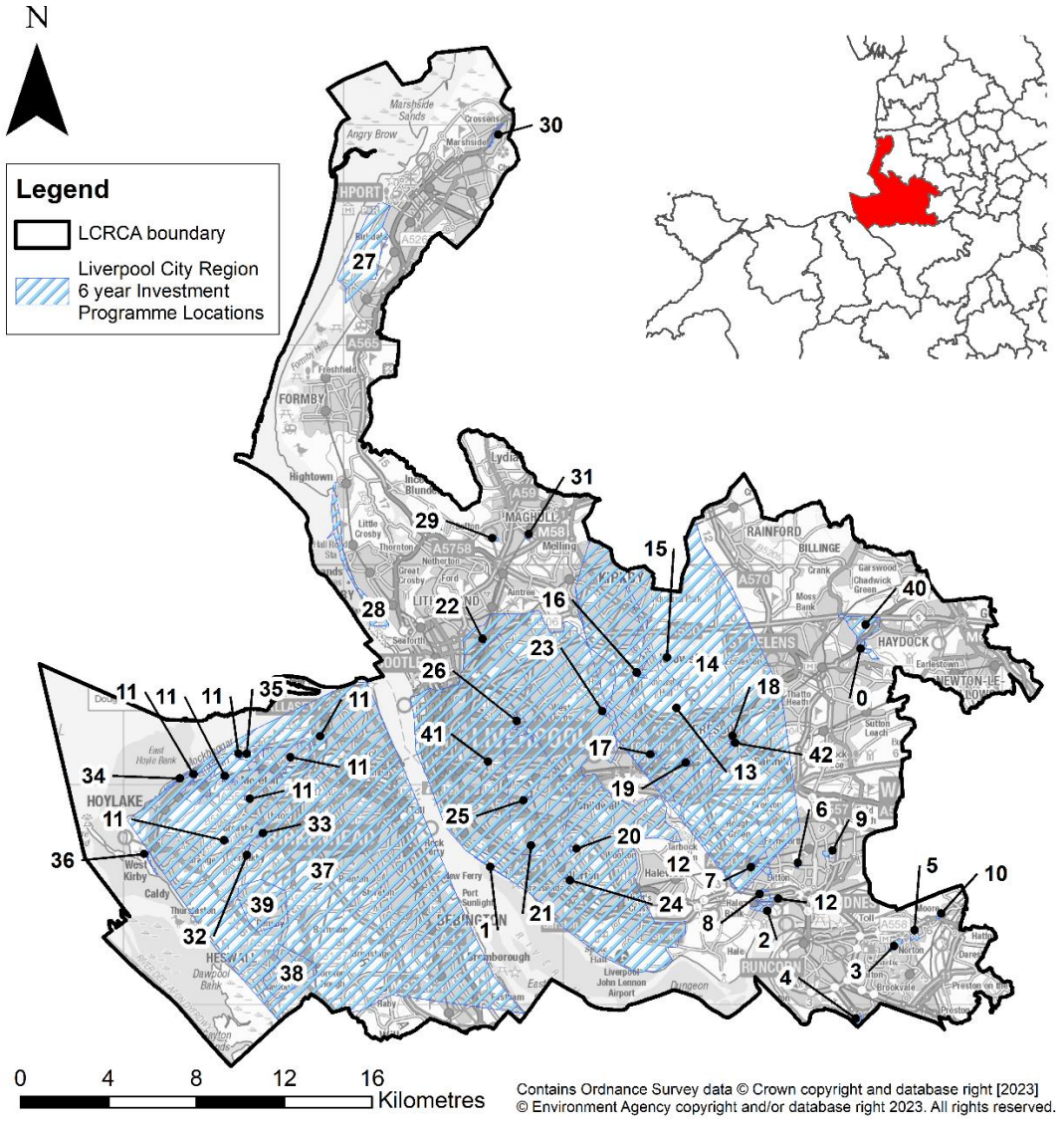

Figure 4-10: Liverpool City Region EA 6-year Investment Programme Locations (July 2022)

5 Development and flood risk

5.1 Introduction

This section of the SFRA summarises the sequential approach and the application of the sequential and exception tests for identifying the suitability of strategic locations in the SDS. The information and guidance provided in this chapter (supported by the SFRA Maps in Appendix B) can be used by the combined authority to inform the SDS and provide the basis from which to apply the sequential approach in the development allocation and development management process. At the SDS level, it is unlikely that the exception test will need to be applied to strategic sites. However, details on the exception test have been included in this chapter for information as it will be applicable to constituent authority local plans.

The SDS, when published, will form part of the 'development plan' for the six constituent authorities alongside their own local plans and neighbourhood plans. SDS policies, when finalised, will therefore be considered when determining planning applications across the City Region. The SDS will only deal with planning matters that are of strategic importance to the City Region. Therefore, its policies will be high level with more detailed planning policies contained in the local plans, reflecting the local circumstances of each constituent authority.

5.2 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. Land at the lowest risk of flooding from all sources should be considered for development, following the requirements of the sequential test.

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

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. the LCRCA in identifying strategic locations for housing and employment development in the SDS, or the constituent LPAs determining planning applications for development.

Whether any further work is needed to decide if the land is suitable for development will depend on both the vulnerability of the development and the flood zone it is proposed

for. Table 2 of the FRCC-PPG[7] defines the flood risk vulnerability and flood zone 'incompatibility' of different development types to flooding, as shown in Figure 5-1.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	X	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	X	X	X	✓ *

Key:

✓ Exception test is not required

X Development should not be permitted

Figure 5-1: FRCC-PPG flood risk vulnerability and flood zone 'incompatibility'

5.3 The sequential test for local plan preparation

The FRCC-PPG, para 024, states the aim of the sequential test is:

"…*to steer new development to areas with the lowest risk of flooding, taking all sources of flood risk and climate change into account."*

The LCRCA and constituent LPAs should seek to avoid inappropriate development in areas at risk of any source 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.

Figure 5-2 presents Diagram 2 of the FRCC-PPG (para 026) which illustrates the sequential test process for plan preparation. 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. Given this is a regional SFRA and therefore not prepared to support the allocation of sites through a local plan, a list of potential development site allocations is not subject to sequential and exception tests. However, the combined authority can use this SFRA to apply the sequential test at a high level on its strategic site decisions.

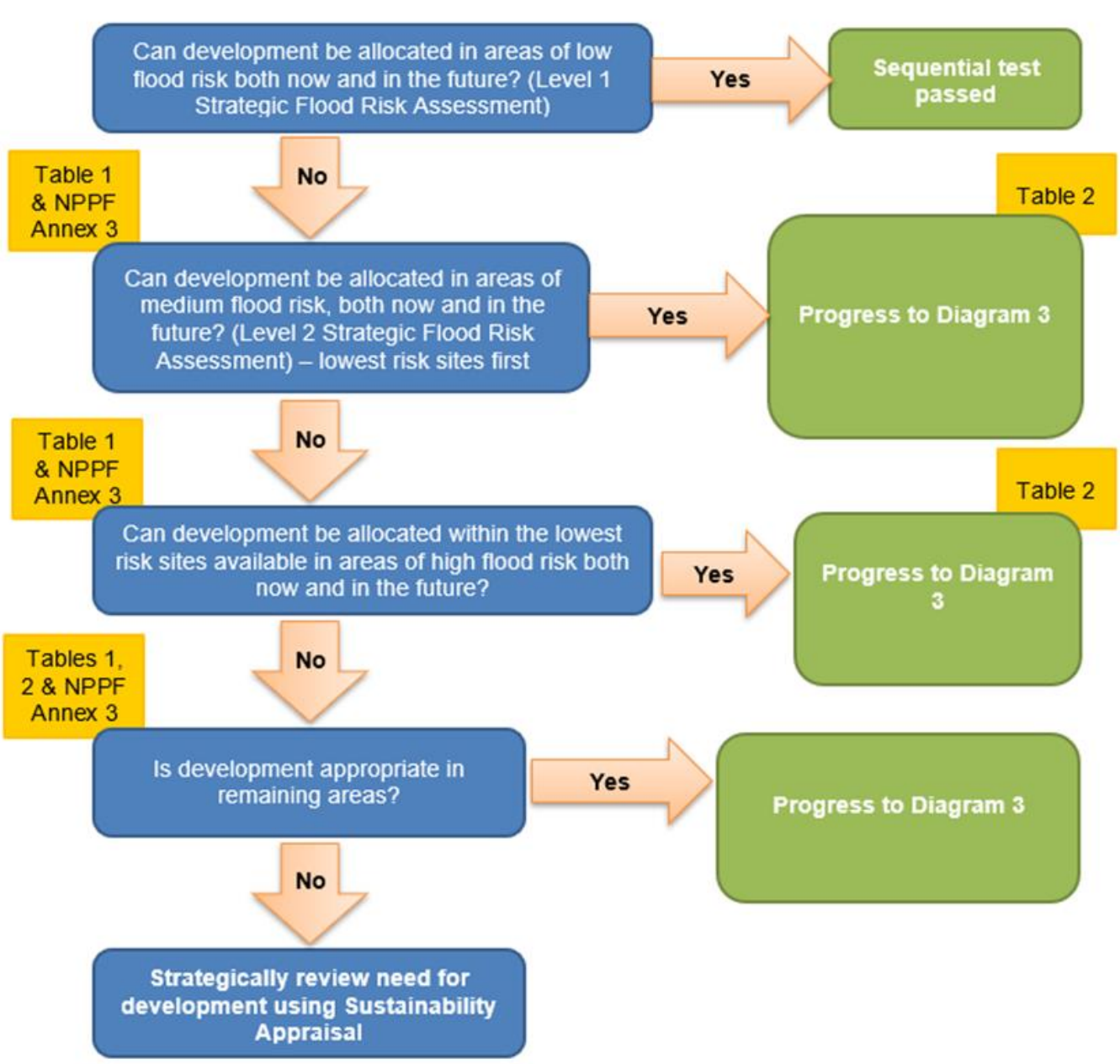

Figure 5-2: Application of the sequential test for plan preparation[18]

Notes on Diagram 2:

- 'Tables 1 and 2' refer to the flood zone and flood risk tables of the FRCC-PPG Paragraphs 078-079
- 'Areas of low flood risk' include:
  - Areas within Flood Zone 1 (rivers),
  - Areas within the low risk surface water flood event extent of the Risk of Flooding from Surface Water map,
  - Areas not at additional risk from climate change.
- 'Areas of medium flood risk' include:
  - Areas within Flood Zone 2 (rivers),
  - Areas within the medium risk surface water flood event extent of the Risk of Flooding from Surface Water map,
  - Areas at risk from Flood Zone 2 plus climate change,
- 'Areas of high flood risk' include:
  - Areas within Flood Zone 3 (rivers),
  - Areas within the high risk surface water flood event extent of the Risk of Flooding from Surface Water map
  - Areas at risk from Flood Zone 3 plus climate change.

Sources of flooding other than fluvial and surface water also need to be considered. For example, if a strategic site is solely within Flood Zone 1 but is at risk from other sources and/or climate change impacts, the sequential test has not been satisfied.

The approach shown in Figure 5-2 provides an open demonstration of the sequential test being applied in line with the NPPF and the FRCC-PPG. This SFRA provides the main evidence required to carry out this process. The process also enables any strategic sites that may pass the sequential test but will require further, more detailed assessment through a Level 2 SFRA or to inform on passing the exception test. *The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in Annex 3 of the NPPF* (para 163).

5.4 The exception test for plan preparation

The NPPF, para 164, states:

"*To pass the exception test it should be demonstrated that:*

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

18 Flood risk and coastal change: paragraph 25, GOV.UK, 2022

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."

As discussed, the exception test is unlikely to be required at the SDS level. However, both elements of the test must be passed to enable allocation in the City Region local plans. A Level 2 SFRA would normally inform on whether the second part of the exception test can be passed, notwithstanding the requirement for a site-specific FRA at the planning application stage. However, as stated in para 166 of the NPPF, the test may need to be reapplied if relevant aspects of a planning proposal had not been considered when the test was first applied to allocate a site in the local plan, or if more recent information about existing or potential flood risk is available and should be accounted for.

Figure 5-3 presents Diagram 2 of the FRCC-PPG (para 033) which illustrates the application of the exception test for allocating sites in local plans. This process should always be informed by a Level 2 SFRA.

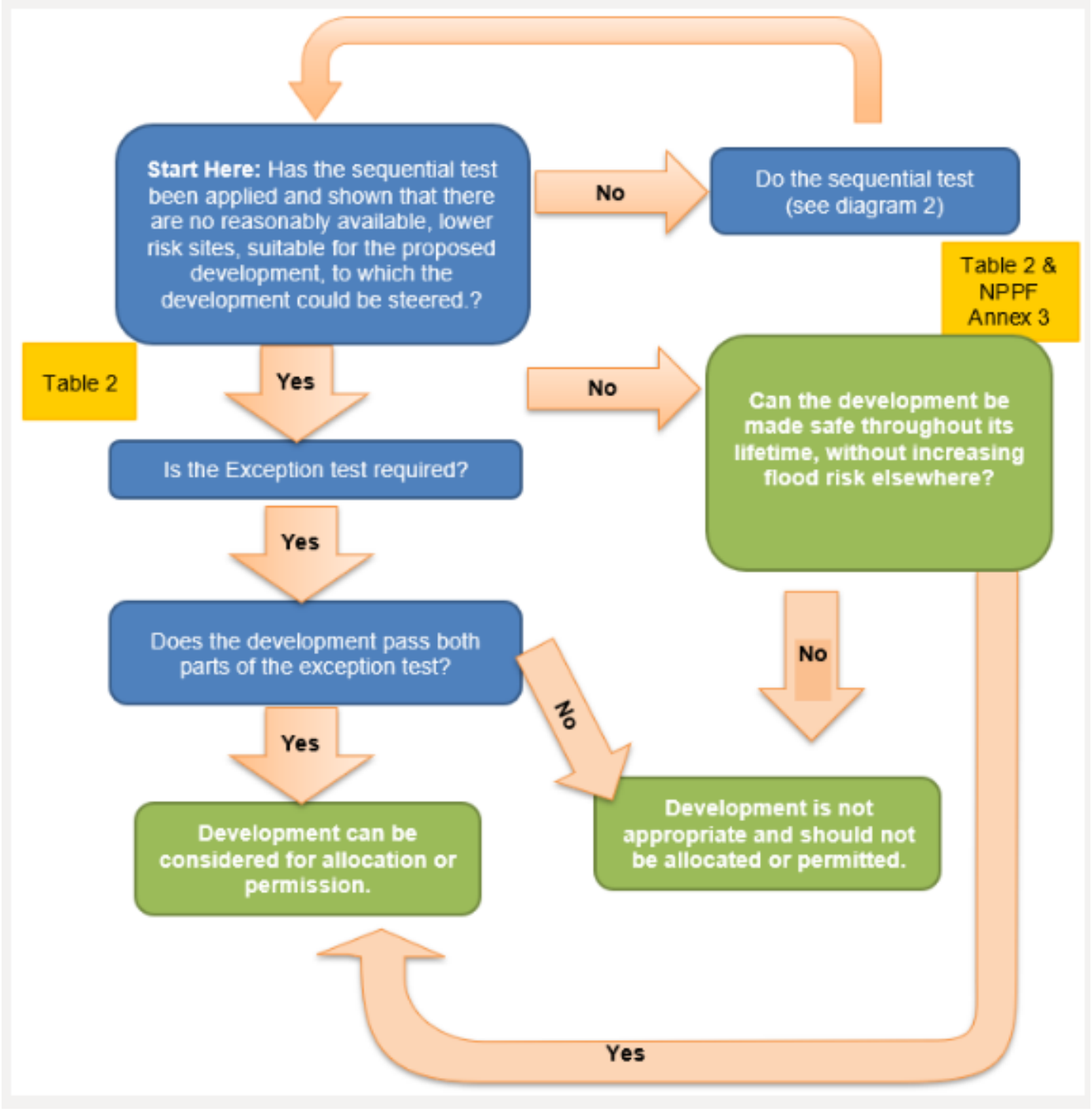

Figure 5-3: Application of the exception test to plan preparation

Where it is found to be unlikely that the exception test can be passed due to few wider sustainability benefits (part a), the risk of flooding being too great (part b), 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 in 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.

5.5 Development management sequential and exception testing

5.5.1 Sequential testing for developers

The constituent LPAs, with advice from the EA, are responsible for considering the extent to which sequential testing considerations have been satisfied for local plan site allocations.

Developers are required to apply the sequential test to all available potential development sites, unless a site is:

- A strategic allocation and the test has already been carried out by the LPA through the local plan process (i.e. as part of its Level 1 SFRA), or
- A change of use (except to a higher vulnerability classification), or
- A minor development (householder development, small non-residential extensions with a footprint of less than 250m^2), or
- A development in Flood Zone 1 unless there are other flooding issues in the area of the development (i.e. surface water, groundwater, sewer flooding, residual risk).

This regional SFRA contains information on all sources of flooding, to the extent that information was made available at publication. This regional SFRA should be considered alongside the applicable local authority SFRA and local guidance when a developer undertakes the sequential test, including the consideration of reasonably available sites at lower flood risk. The impacts of climate change on all sources of flood risk, where feasible, should be robustly accounted for.

Local circumstances must be used to define the area of application of the sequential test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. For some sites this may be clear e.g. school catchments, in other cases it may be identified by other local plan policies. For some sites e.g. regional distribution sites, it may be suitable to widen the search area beyond administrative boundaries. The applicable LPA should be consulted before deciding on the appropriate search area.

The sources of information on reasonably available sites may include:

- Site allocations in the LPAs local plan,
- Sites with planning permission but not yet built,
- Strategic Housing and Economic Land Availability Assessments (SHELAAs) / five-year land supply / annual monitoring reports
- Locally listed sites for sale.

It may be that a number of smaller sites or part of a larger site at lower flood risk form a suitable alternative to a development site at high flood risk. Ownership or landowner agreement is not acceptable as a reason not to consider alternatives.

5.5.2 Exception testing for developers

If, following application of the sequential test it has been agreed with the LPA that it is not possible for the development to be located in areas with a lower probability of flooding, the exception test must then be applied, depending on the vulnerability classification of the site (see Figure 5-1), as part of the FRA. Developers are required to apply the exception test to all applicable sites (including strategic allocations).

The applicant will need to provide information that the application can pass both parts of the exception test by:

- Demonstrating that the development would provide wider sustainability benefits to the community that outweigh the flood risk (part a).
- Referring to wider sustainability objectives in the local plan Sustainability Appraisal. These generally consider matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.
- Detailing the suitability issues the development will address and how doing it will outweigh the flood risk concerns for the site e.g. by facilitating wider regeneration of an area, contributing to the local economy, providing community facilities, infrastructure that benefits the wider area, etc.
- Demonstrating that 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 (part b).
- Demonstrating that the site will be safe, and site users will not be exposed to hazardous flooding from any source. The FRA should consider actual and residual risk and how this will be managed over the lifetime of the development, including:
    - The design of any flood defence infrastructure, including operation and maintenance,
    - Availability of dry access and egress routes during a flood,
    - Design of the development to manage and reduce flood risk wherever possible i.e. through SuDS, including for designated ownership and maintenance procedures,
    - Resident awareness through appropriate emergency plans and signposting / signage,
- Emergency planning, flood warning and evacuation procedures, including whether the development would increase the pressure on emergency services to rescue people during a flood event, and

- Any funding arrangements required for implementing mitigation measures including for maintenance procedures and defining ownership.

5.6 Site-specific Flood Risk Assessment

The principal aims of a FRA are to determine the level of flood risk to a site and to confirm that suitable flood management measures can be developed to control flooding, and safeguard life and property, without increasing risk to the surrounding area, for the lifetime of the development.

Once the site has been sequentially tested and has been identified as being likely to pass the exception test through a Level 2 SFRA, a site-specific FRA should be undertaken by the developer as part of a planning application. The LPA, LLFA and EA should be consulted to determine the content and scope of the FRA.

Alongside national guidance, LPA criteria on when to submit a site-specific Flood Risk Assessment should be consulted.

The production of a site-specific FRA can be seen as an iterative process by subdividing the FRA into three stages:

- Stage 1 is a screening study used to identify whether there are any flood risk issues that need to be considered further i.e. reviewing this regional SFRA and applicable constituent authority SFRA outcomes;
- Stage 2 is a scoping study that should be undertaken if the Stage 1 FRA indicates that there are flood risk issues that need further consideration; and
- Stage 3 is a detailed study where further quantitative analysis is required to fully assess flood issues and confirm that effective mitigation measures can be implemented to control flood risk and that the second part of the exception test can be passed.

It is appropriate to review the level of risk present and assess whether development is appropriate and achievable at each stage of the assessment.

The SFRA is an assessment of flood risk at a strategic level. This information can be used to provide evidence for Stages 1 and 2 of the FRA. Where a more detailed FRA is required (Stage 3), then a developer should undertake a detailed assessment of the flood risk at the site which would likely include appropriate flood modelling.

Significant consultation with the LPA and key consultees and stakeholders that are relevant to the site will be required for complex development proposals. Complex developments may need to include flood mitigation measures and compensatory storage.

Together with appropriate consultation, accepted FRA guidance should be followed by developers including:

- Find out when you need to do an FRA as part of a planning application, how to complete one and how it's processed:
  - Flood risk assessments if you're applying for planning permission
  - Flood risk assessment in flood zones 2 and 3
  - Flood risk assessment in flood zone 1 and critical drainage areas
- EA standing advice:
  - Preparing a flood risk assessment: standing advice

In summary, the FRA should address the following:

1. **Development description and location**
   a. What is the type of development and where will it be located?
   b. What is the vulnerability classification (Table 2 of FRCC-PPG) of the current and future building use?
   c. Has the development site been assessed in the SFRA? If so, has the sequential test been carried out? Has the exception test (if applicable) been applied and passed previously?
2. **Access and egress**
   a. Can safe access and egress routes be achieved during a flood event?
   b. Safe access and escape routes should be explicitly identified as part of an agreed emergency plan.
3. **Definition of flood hazard**
   a. What are the sources of flooding at the site?
   b. For each source how would flooding occur? Referencing any historical records
   c. What existing surface water drainage infrastructure is present on the site? Consultation required with LPA, LLFA, EA and water companies)
4. **Probability**
   a. Confirm the flood zone designation for the site (refer to the Flood Map for Planning: Flood Map for planning)
   b. Determine the actual and residual risks at the site (refer to the SFRA maps and EA modelled depth and hazard information)
   c. What are the discharge rates and volumes generated by the existing site and proposed development?
5. **Climate change**
   a. How is flood risk at the site likely to be affected by climate change?
   b. Check appropriate allowances (Section 4.12.1):
   c. Flood risk assessments: climate change allowances
6. **Flood Risk Management measures**

a. How will the site be protected from flooding, including the potential impacts of climate change, over the lifetime of the development?

7. **Residual risks**
   a. What are the consequences to the site of flood defence failure? Breach / overtopping scenarios should be modelled.
   b. What are the consequences to the site of asset blockage? Culvert, bridge blockage scenarios should be modelled.
   c. Is there residual risk from reservoirs? If so, how can this be mitigated and does the emergency plan address such risk? Reference the EA's Reservoir Flood Map: Reservoir flood risk
   d. Is there residual from canals? If so, how can this be mitigated and does the emergency plan address such risk? Consultation required with the EA, LLFA and Canal & River Trust (if applicable). Breach / overtopping scenarios should be modelled.
   e. What flood related risks will remain after mitigation measures have been implemented?
   f. How, and by whom, will these risks be managed over the lifetime of the development?
8. **Offsite impacts**
   a. How will the proposed development ensure there are no impacts to other development downstream or nearby?
   b. What measures will be implemented to control surface water runoff? SuDS? What arrangements are in place for SuDS ownership, maintenance?
9. **Groundwater**
   a. This mechanism of flooding should be considered particularly when determining the acceptability of SuDS schemes as a way of managing surface water drainage. Developers should consult with the LPA, LLFA and EA at an early stage of the assessment.
10. **Sewer systems**
   a. Where the SFRA has identified a risk of surface water flooding, any water that escapes from the sewer system would tend to follow similar flow paths and pond in similar locations. The SFRA should also contain historical evidence to refer to.
   b. Where required, liaison with the relevant water company should be undertaken at an early stage in the assessment process to confirm localised sewer flooding problems that could affect the site.
   c. Future development should be designed so that it does not exacerbate existing sewer capacity problems. Developers should check with the LPA whether a Water Cycle Study has been developed.

5.7 Surface water management and Sustainable Drainage Systems

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

The Department for Levelling Up, Housing and Communities (DLUHC) (formally the Department for Communities and Local Government) announced, in December 2014, that the LPA, in consultation with the LLFA, should be responsible for delivering SuDS[19] through the planning system. Changes to planning legislation gave provisions for major applications of ten or more residential units or equivalent commercial development to require sustainable drainage within the development proposals in accordance with the 'non-statutory technical standards for sustainable drainage systems'[20], published in March 2015. A Practice Guidance[21] document has also been developed by the Local Authority SuDS Officer Organisation (LASOO) to assist in the application of the non-statutory technical standards.

As discussed in Appendix A, an independent review into the implementation of Schedule 3 of the FWMA was commissioned by Government and published in January 2023. The review concluded that the delivery of SuDS should not be made entirely through the planning process and recommended that Schedule 3 be implemented subject to final decisions on scope, threshold, and process. It was also recommended that that the non-statutory technical standards for sustainable drainage

systems should be made statutory. Government accepted the recommendations. The implementation of Schedule 3 expected in 2024.

The Design and Construction Guidance (DCG) for sewers became the regulated sewerage guidance on 1 April 2020. This allows water and sewerage companies to

19 Sustainable Drainage Systems | UK Parliament | 2014
20 Sustainable Drainage Systems | Defra | 2015
21 Non-Statutory Technical Standards for Sustainable Drainage | LASOO | 2016

adopt SuDS components that meet the criteria of the DCG. Details on the sewerage sector guidance can be found online via: Sewerage Sector Guidance, a changed approach to surface water sewers | Water UK

5.7.1 Sustainable drainage in the Liverpool City Region

In order to manage flood risk, all development, regardless of development type, flood zone and development size, must give priority use to SuDS. Particularly for major developments, there is a requirement to assess and include SuDS for managing surface water at the development unless it is demonstrated during the assessment that it is inappropriate for the site i.e. due to high groundwater levels not allowing for infiltration SuDS.

To satisfy the NPPF, applicants must demonstrate that priority has been given to the use of SuDS in their development proposals. SuDS should be provided by default unless demonstrated to be inappropriate. Where priority use of SuDS cannot be achieved, applicants must justify this by submitting robust and acceptable evidence.

The City Region LPAs have each developed their own local SuDS guidance for developers to set out how surface water from a development site will be managed sustainably:

- Halton Sustainable Drainage Statement (2019)
- Knowsley Sustainable Drainage Systems Advice Note (2019)
- Liverpool City Region Sustainable Urban Development Strategy (2016)
- Sefton Sustainable Drainage and Flood Risk Information Note (2018)
- St Helens Sustainable Drainage Systems Design and Technical Guidance (2018)
- Wirral Sustainable Drainage & Surface Water Management Technical Guidance.

In addition to the above SuDS guidance documents, the North-West SuDS proforma should be submitted alongside planning applications. The proforma provides consistency in the approach applied to SuDS requirements across the North-West and is designed to increase the effectiveness of SuDS as a tool to reduce surface water flood risk associated with development. This proforma has been created for the North-West, sponsored and endorsed by the North-West Regional Flood and Coastal Committee (NWRFCC) and UU, and has been developed by a task group of representatives from UU, North-West local authorities and the EA, all of whom planning authorities may need to consult on surface water drainage matters. The proforma has then been widely consulted on and developed further based on the feedback received. The North-West SuDS proforma has been included within Appendix E.

For development within Sefton, there is a requirement for all major development to complete the Sefton specific SuDS Pro Forma as part of the planning application process; not the North-West SuDS Pro Forma.

5.7.2 SuDS and the NPPF

The NPPF, 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.

Sustainable drainage should form part of an integrated design methodology secured by detailed planning conditions to ensure that the SuDS to be constructed is maintained to a minimum level of effectiveness. SuDS maintenance options must:

- Clearly identify who will be responsible for maintaining the SuDS,
- Set out a minimum standard to which the SuDS must be maintained, and
- Ensure funding for SuDS maintenance is fair for householders and premises occupiers.

5.7.3 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:

1. To ground,
2. To surface waterbody,
3. To surface water sewer, or
4. To combined sewer.

Effects on water quality should be investigated when considering runoff destination in terms of the potential hazards arising from development and the sensitivity of the runoff destination.

The EA may also look at the potential impact of an outfall structure through the planning consultation and Environmental Permitting Regulation[22] 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[21] (March 2015).

The non-statutory technical standards for sustainable drainage systems 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, and
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 (Figure 5-4), will be required, where source control is the primary aim. Source control includes interception of the first 5mm rainfall and water quality treatment as near to source as possible.

In February 2021, Defra published its research project to review and provide recommendations to update the current non-statutory technical standards for sustainable drainage systems[23]. Defra will use this research to inform its drainage policy development. Based on the research findings, recommendations have been made to replace the current standards 1 to 7 with a new suite of six standards to cover the following:

1. Runoff destinations
2. Everyday rainfall
3. Extreme rainfall
4. Water quality
5. Amenity
6. Biodiversity.

22 Environmental permits: detailed information | Environment Agency

23 Defra (2021) Recommendations to Update Non-Statutory Technical Standards for Sustainable Drainage Systems (SuDS) - WT15122

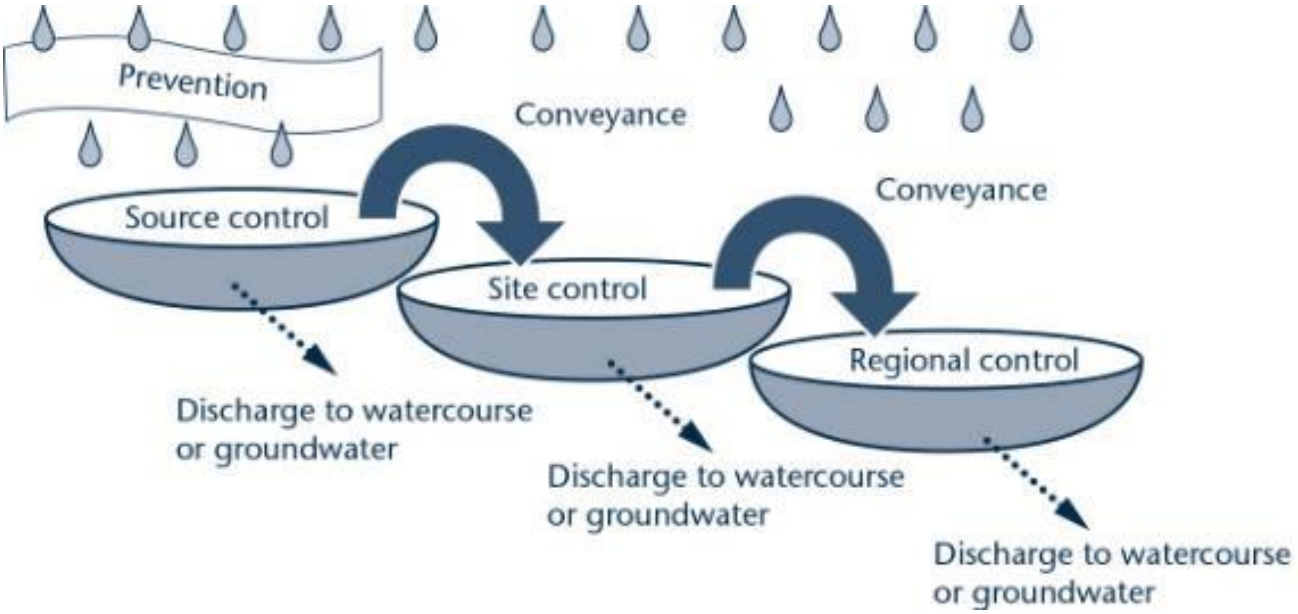

Figure 5-4: SuDS management train principle[24]

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, LPA's may set local requirements for planning permission that include more rigorous obligations than the non-statutory technical standards, as stated in Section 5.7. 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[25] 2015 should also be consulted by LPA's 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

24 CIRIA (2008) Sustainable Drainage Systems: promoting good practice – a CIRIA initiative

25 CIRIA (2008) | CIRIA SuDS Manual

complements the non-statutory technical standards and goes further to support the cost-effective delivery of multiple benefits.

5.7.4 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.

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 FRA, the likely extents, depths and associated hazards of surface water flooding on a development site, as initially indicated by the RoFSW dataset. This is an appropriate approach to reduce the risk of flooding to new developments. Green / blue infrastructure should be used wherever possible to accommodate such flow paths. EA standing advice states that finished floor levels should always be set a minimum of 300 mm above ground level (or 300 mm freeboard above the design flood level) 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.

5.8 Mitigation measures

Whilst the sequential approach to development and flood risk should always be followed, there are certain instances where development must occur in areas of flood risk. This section details the generic mitigation measures that are available for new development and also for existing developments at flood risk. LPA Local Plan policies and supplementary local requirements for mitigation measures should be considered alongside the requirements set out within this SFRA.

5.8.1 Site layout and design

Flood risk should be considered at the first stage in planning the layout and design of a site to provide an opportunity to reduce flood risk within the development.

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from areas of flood risk for example to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational

space) can be located in higher risk areas which may be on lower ground. Whether parking in floodplains is appropriate will be based on the likely flood depths and hazard, evacuation procedures and availability of flood warning.

Waterside areas, or areas alongside known flow routes, can act as green / blue infrastructure, being used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas and avoid the creation of isolated islands as water levels rise.

5.8.2 Sustainable Drainage Systems

SuDS provide a means of dealing with the quantity and quality of surface water and can also provide amenity and biodiversity benefits. Given the flexible nature of SuDS they can be used in most situations within new developments as well as being retrofitted into existing developments. SuDS can also be designed to fit into most spaces. For example, permeable paving could be used in parking spaces or rainwater gardens as part of traffic calming measures.

The developer is responsible for ensuring the design, construction and future/ongoing maintenance of any SuDS scheme is carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and current drainage arrangements is essential.

5.8.3 Modification of ground levels

Any proposal for modification of ground levels will need to be assessed as part of a detailed FRA.

Modifying ground levels to raise land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for floodwaters. However, care must be taken as raising land above the floodplain could reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land. Raising ground levels can also deflect flood flows, so analyses through modelling should be performed to demonstrate that there are no adverse effects on third party land or property.

Compensatory flood storage should be provided, and would normally be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated). Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624[26].

26 CIRIA January 2004, CIRIA Report 624: Development and Flood Risk - Guidance for

Where proposed development results in a change in building footprint, the developer should ensure that it does not impact upon the ability of the floodplain to store or convey water and seek opportunities to provide floodplain betterment.

Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested through appropriate modelling to ensure that it would not cause increased ponding or build-up of surface runoff on third party land.

5.8.4 Raised floor levels

If raised floor levels are proposed, these should be agreed with the LPA and the EA. The minimum Finished Floor Level (FFL) may change dependent upon the vulnerability and flood risk to the development.

EA standing advice[27] states:

Finished floor levels should be a minimum of whichever is higher of 300mm above the:

- *average ground level of the site,*
- *adjacent road level to the building,*
- *estimated river or sea flood level.*

Where floor levels cannot be raised to meet the minimum requirement, the developer must do the following:

- *raise them as much as possible,*
- *consider moving vulnerable uses to upper floors,*
- *include extra flood resistance and resilience measures.*

Where a development is designed to provide protection against 600mm of more of floodwater, advice should be sought from a structural engineer to check and confirm the safety of the design. Additional allowance may be required where there are residual risks relating to blockages to the river channel, culvert or bridge structures and should be considered as part of the FRA.

Allocating the ground floor of a building for less vulnerable, non-residential, use is an effective way of raising living space above flood levels. Single storey buildings such as ground floor flats or bungalows are especially vulnerable to the rapid rise of floodwater (such as that experienced during a defence breach). This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route from the development to safe areas.

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 and areas at risk of surface water flooding in the high or medium surface

the Construction Industry

27 Guidance | Preparing a flood risk assessment: standing advice | Environment Agency | February 2022

water flood zones of the RoFSW should not be permitted, whilst basement dwellings in Flood Zone 2 will be required to pass the exception test as the use becomes highly vulnerable. Access should be situated 300 mm above the design flood level and waterproof construction techniques used.

5.8.5 Property Flood Resilience (PFR)

Para 167 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. Such 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.

The 'Code of practice for property flood resilience', published by CIRIA in 2021[28], defines active PFR measures as *'…measures which are not permanently installed into the property and will require deployment before a flood event (e.g. a door guard)*'. Passive PFR measures are defined as '…*measures which are installed into the property and do not require further deployment or activation before a flood event (e.g. a flood door or automatic airbrick cover)*'.

Research[29] carried out by the then DCLG (now DLUHC) and the EA recommended that the use of resistance measures should generally be limited to a nominal protection height of 600 mm 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. The EA recommends that advice from a structural engineer should be sought for any measures to resist a depth of 600 mm or more.

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 water pumps of a sufficient capacity. Pumps help manage residual flood risks not addressed by resistance measures alone such as rising groundwater levels.

28 CIRIA (2021) Code of practice for property flood resilience (C790F)

29 DCLG & EA (2007) Improving the Flood Performance of New Buildings - Flood Resilient Construction

5.8.5.1 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, floodwater 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.

5.8.5.2 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 floodwater arriving at the property (e.g. along road, pavements, etc.). The depth of flooding recorded at a property will help guide the selection of the most appropriate PFR measures. Surveys will need to include:

- Detailed property information i.e. structure, presence of air bricks, cellars, outlet pipes, floor levels, door and window levels, manhole and grid locations,
- An assessment of flood risk, including property (cross) threshold levels,
- Routes of water ingress (fluvial, ground and surface water flooding),
- An assessment of the impact of floodwaters,
- A schedule of recommended measures to help to reduce risk,
- Details of recommendations (including indicative costs),
- Advice on future maintenance of measures, and
- Advice on flood preparedness and emergency planning.

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 identification of possible weaknesses in any deteriorating brickwork or mortar.

5.9 Emergency Planning

The provisions for emergency planning for local authorities as Category 1 responders are set out by the Civil Contingencies Act, 2004[30] and the National Flood Emergency Framework for England, December 2014[31]. 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 those involved 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 flood 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 EA and the Association of Directors of Environment, Economy, Planning and Transport (ADEPT) have produced guidance on flood risk emergency plans for new development[32] (September 2019). It would however be for the LCRCA to review and approve flood risk emergency plans with their emergency planners or through the Local Resilience Forum.

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 to emergency planners to help prepare for any flood event and throughout the planning process.

30 Civil Contingencies Act, GOV.UK, 2004
31 The national flood emergency framework for England | GOV.UK | 2014
32 Flood Risk Emergency Plans for New Development | ADEPT/EA | September 2019

5.9.1 Civil Contingencies Act

Under the Civil Contingencies Act (CCA, 2004)[33], the LLFA and the LCRCA 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,
- 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.

5.9.1.1 Merseyside Resilience Forum (MRF)[34] and Cheshire Resilience Forum (CRF)[35]

The aim of a resilience forum is to legally deliver the duties stated in the Civil Contingencies Act 2004 within a multi-agency environment. The Merseyside and Cheshire Resilience Forums are groups of organisations that work together to prepare and respond to emergencies across the City Region. The MRF covers Wirral, Liverpool, Sefton, Knowsley and St Helens, and the CRF covers Halton. The resilience forums involve local authorities, emergency services, health agencies, EA and local businesses.

The MRF and CRF'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.

33 The Civil Contingencies Act | GOV.UK | 2013
34 Merseyside Prepared | Merseyside Resilience Forum | Planning for Emergencies
35 Cheshire Resilience Forum

The MRF and CRF's main roles include:

- Assessing the impacts of the risks 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.

5.9.1.2 Community Risk Register[36][37]

The resilience forums covering the Liverpool City Region both produce Community Risk Registers (CRR) which list possible risks, the probability of the risk occurring and the potential impacts. The CRR's provide information on the biggest emergencies that happen in the City Region, together with an assessment of how likely they are to happen and the impacts on 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 the potential impact on safety and security, health, economy, environment and society.

5.9.1.3 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 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 Government's website[38].

Each constituent LLFA listed below has produced guidance and emergency plans on how to prepare and respond to emergencies, these are available from:

- Halton - Major Emergency Plan, Halton Borough Council, 2021
- Liverpool - Emergency Planning, Liverpool City Council
- Sefton - Emergency Planning, Sefton Council
- Wirral - Emergencies, Wirral Council

36 Merseyside Community Risk Register 2022 | Planning for Emergencies | Merseyside Resilience Forum

37 Making Cheshire Safer | Community Information on Risks in Cheshire | Cheshire Fire and Rescue Service for Cheshire Resilience Forum

38 Resilience in society: infrastructure, communities and businesses | Cabinet Office | 2014

5.9.1.4 Local flood plans

This SFRA along with the constituent authorities own SFRAs, provide a number of flood risk data sources that can be referred to when producing or updating local flood plans. The LCRCA and constituent LPAs will be unable to write their own specific flood plans for new developments at flood risk. Developers should write their own alongside a site-specific Flood Risk Assessment. 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 risk data and information provided in this SFRA can help to:

- Update local flood plans if appropriate,
- Inform emergency planners in understanding the possibility, likelihood and spatial distribution of all sources of flooding,
- 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 EA and ADEPT is aimed at local authorities to help assist in setting up their own guidelines on what should be included in flood risk emergency plans: Flood Risk Emergency Plans for New Development | ADEPT / EA | 2019.

5.10 Flood warning and evacuation plans

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

In relation to a 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 a development can be considered safe without the provision of safe access and egress, then planning permission should be refused.

Whilst there is no statutory requirement on the EA or the emergency services to approve evacuation plans, the 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 LPAs between emergency planners and policy planners / development management officers, the LLFA, drainage engineers and also the LCRCA and external stakeholders such as the emergency services, the EA, UU, and Canal & River Trust.

It may be useful for both the LLFAs and spatial planners 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. 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 receives planning permission, 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.

At the time of writing there are 34 Flood Warning Areas within the City Region located primarily along main rivers and at the coast.

5.10.1 What should a flood warning and evacuation plan include?

Flood warning and evacuation plans should include the information stated in Table 5-1. Advice and guidance on plans are accessible from the EA website and plan templates are available for businesses and local communities.

Table 5-1: Flood warning and evacuation plans

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	Everyone eligible to receive flood warning

Consideration	Purpose
occupant's awareness of the likely frequency and duration of flood events	should be signed up to the EA flood warning service. Where applicable, the display of flood warning signs should be considered. Particularly 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 site staff, occupants, or 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 source, 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 i.e. elderly, less able, children are more vulnerable.
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.
Mental health	Exposure to a flood event i.e. having your home flooded can have severe effects on the mental health of those affected. There should be guidance on how to get help with mental issues.

5.10.2 EA Flood Warning Areas (FWA) and flood awareness

The EA monitors river levels within the main rivers affecting the City Region and based upon weather predictions provided by The Met Office, assesses 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 defined FWAs, 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:

Flood warnings

Live information on flood warning and flood alerts is available via:

Check for flooding in England

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, 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 and / or tidal flood risk to sign up to the EA's Flood Warning service.

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.

6 Conclusions and recommendations

6.1 Conclusions

This regional SFRA provides a single repository strategic planning tool relating to flood risk and development within the LCRCA. Key flood risk stakeholders namely the EA, constituent authorities, UU and Canal & River Trust were consulted to collate all available and relevant flood risk information on all sources both now and in the future into one comprehensive high-level assessment.

The impacts of climate change on fluvial, coastal and surface water flood risk have been modelled and mapped where possible to assist the LCRCA and its constituent authorities in planning sustainable development with future flood risk in mind.

Together with this report, this SFRA also provides a suite of interactive GeoPDF SFRA Maps.

The flood risk information, assessment, guidance and recommendations of this regional SFRA will provide the combined authority and the constituent authorities with the evidence base required to apply the sequential test to strategic sites, as required under the NPPF and demonstrate that a risk-based, sequential approach has been applied in the preparation of its new Spatial Development Strategy.

Whilst the aim of the sequential approach is the avoidance of high flood risk areas, in some locations where the combined authority 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, detailed local information on flood risk is not fully accounted for.

The data and information used throughout the SFRA process is the most up-to-date data available at the time of publication. Once new, updated or further information becomes available, the combined authority should look to update this SFRA. The SFRA should be and be maintained as, a ‘live’ entity which is updated as and when required (when new modelling or flood risk information becomes available).

6.1.1 Summary of risk in the City Region

Based on the Flood Map for Planning:

- Tidal flood risk is greatest:
    - Sefton - Marshside and Crossens in the north; south of Formby and north of Hightown in the south,
    - Wirral - along the north coast around Leasowe and Meols and to large areas of agricultural land; Birkenhead from the Mersey Estuary; Bromborough Pool

from Dibbinsdale Brook and Mersey Estuary; West Kirby along South Parade,
    - Liverpool - around the docks from the Mersey Estuary
    - Halton - north and east of Hale from the Mersey Estuary and Ram's Brook; Hale Bank from the Mersey Estuary and Ditton Brook.
- Fluvial risk is greatest:
    - Sefton - east of Formby; parts of Maghull,
    - Wirral - Birkenhead; Clatterbridge Hospital,
    - Liverpool - Norris Green,
    - Knowsley - Bowring Park; Halewood,
    - Halton - Widnes; Keckwick,
    - St Helens - Sutton; Peasley Cross; Denton's Green; Eccleston.

Areas at greatest risk from surface water according to the Risk of Flooding from Surface Water map are difficult to define. It is clear that the majority of urban areas are at some risk from surface water flooding.

Based on the JBA 5m Groundwater Flood Map, the majority of Sefton, particularly Crossens, Marshside, Maghull and Aintree are at risk. Other notable locations at higher risk include Netherley and Belle Vale in Liverpool; Stockbridge Village and Huyton in Knowsley; St Helens town centre, Rainford and Newton le Willows in St Helens; Clatterbridge Hospital and Woodchurch in Wirral.

Reservoir flooding has the potential to affect all six districts within the City Region, with the areas with the most widespread risk being Knowsley, Halton and St Helens.

6.2 Data gaps

Gaps in data and information have become apparent throughout the preparation of this SFRA. It may be the case that this information does not exist or has not been made available for the SFRA for unknown reasons. Such gaps in information includes:

- Constituent authorities up to date historic flood records and asset register details,
- EA fluvial and tidal hydraulic modelling for the following locations:
    - Bowers Brook - detailed Infoworks model not suitable for use in SFRA,
    - Childwall Brook (HEC-RAS) - model is not georeferenced, low accuracy of flood mapping,
    - Childwall Brook (JFLOW) - unsupported model in old version of software,
    - Court Hey Brook - model is not georeferenced, low accuracy of flood mapping,
    - Hardshaw Brook - detailed Mike 11 model not suitable for use in SFRA,
    - Jacks/Millingford Brooks - detailed Infoworks model not suitable for use in SFRA,
    - Lower Weaver - majority of model domain outside of combined authority boundary therefore not updated,

- Sherdley Brook - missing model files not supplied,
- St Helens - detailed Mike 11 model not suitable for use in SFRA,
- Upper Childwall - missing model files not supplied,
- Mill and Windle - missing model files not supplied.
- Dee tidal - model files not supplied for use within this SFRA.

6.3 Recommendations for further work

There are a number of plans, studies and assessments listed in Table 6-1 that may be of benefit to the LCRCA and the constituent authorities, in developing the flood risk evidence base to support the delivery of the SDS, local plans, or to the LLFAs to help fill critical gaps in flood risk information that have become apparent through the preparation of this SFRA.

Type	Study	Reason	Timeframe
Understanding of local flood risk	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 SDS or relevant local development documents; local flood management schemes; flood risk management plans; shoreline management plan; local flood risk management strategies; and national or local planning policy or guidance. Or after a significant flood event.	As required
	SFRA update	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 <3 km^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
	SFRA update	Climate change modelling and	Short term

Type	Study	Reason	Timeframe
		functional floodplain updates for those locations listed in Section 6.2 of this report.	
	Detailed flood risk screening of SDS strategic locations	Strategic sites should be assessed against all flood risk information for inclusion in the SDS.	Short term
	Preliminary site-screening FRAs / Level 2 SFRA	Further, more detailed assessment of the strategic sites.	Short term
	SWMP / detailed surface water modelling	Sefton Council and Halton Council have produced SWMP's to understand the causes and effects of surface water flooding within their districts. It is recommended that these SWMP's are updated to incorporate the impacts of climate change. It is also recommended that the other authorities ascertain whether locations at high surface water flood risk would benefit from a SWMP.	Short to medium term
	Water Cycle Study (WCS)	A WCS is recommended for any areas of new large strategic development.	Short term. Water Cycle Studies have been produced for the Wirral Liverpool and Mersey Heartlands Growth Point, Wirral Council and the Mid Mersey.

Type	Study	Reason	Timeframe
Flood storage and attenuation	Working with Natural Processes	Further assess WwNP options in upper catchments to gauge possible areas for Natural Flood Management. Promote creation of floodplain and riparian woodland, floodplain reconnection and runoff attenuation features where the research indicates that it would be beneficial within the region.	Short term
Data collection	Flood Incident data	Constituent authorities should actively record flood events including such information as 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.	Ongoing for Wirral Council, Halton Council and Sefton Council. Flood incident data has not been made available by Liverpool Council, Knowsley Council and St Helens Council.
	FRM Asset Register	Constituent authorities should continue to update and maintain registers of structures and features, which are considered to have an effect on flood risk.	Assumed ongoing
Risk Assessment	Asset Register Risk Assessment	The LLFAs should carry out a strategic flood risk assessment of structures and features on the Asset Register to inform capital programme and prioritise maintenance programme.	Short term / ongoing

Type	Study	Reason	Timeframe
Capacity	SuDS review / guidance	The constituent LLFAs and LPAs should clearly identify requirements of developers for SuDS in new developments. Internal capacity, within the constituent authorities, should be in place to deal with SuDS applications, set local specification and set policy for adoption and future maintenance of SuDS. The LCRCA may look to adopt a consistent SuDS policy across the City Region.	Short term
Partnership	Local authorities	The LCRCA should continue to work with the constituent authorities on flood risk matters and strategic planning matters	Ongoing
	United Utilities	The LCRCA and the constituent authorities should continue to collaborate with UU on sewer and surface water projects. They should work with UU to ensure their assets can remain operational and resilient at all times across the catchment and that capacity for new development is appropriate.	Ongoing
	EA	The LCRCA and constituent authorities should continue to work with the EA on fluvial and tidal 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 the LCRCA's existing flood risk partnerships and the SDS.	Ongoing

Table 6-1: Plans and assessments beneficial to developing the flood risk evidence base

6.3.1 Appraisal of strategic locations

An appraisal of strategic locations will be required in order to inform the regulatory 'Public Participation' (stage 3) of the SDS. This appraisal should provide an

assessment of flood risk of any proposed strategic growth locations and inform a final Sustainability Appraisal and Strategic Infrastructure Plan. The LPA should be consulted on and agree all appraisals for sites within their local council area.

Data and information gathered throughout the preparation of this SFRA will be used in the appraisal. However, any updated datasets or information, i.e. the EA's Flood Map for Planning, will be used to inform the appraisal.

Further evidencing, i.e. climate change modelling for watercourses not modelled in the SFRA, may be required to inform the appraisal, depending on the locations of strategic sites.

The appraisal will build on the source information provided in this SFRA and should show that a site will not increase risk elsewhere and will be safe for its lifetime, once developed. The appraisal may also further assess locations and options, in more detail, for the safeguarding of open space, or Green Infrastructure, to help manage flood risk in key areas and also to assess residual risk.

A Appendix A - Planning Policy and Flood Risk Management

This section contains information relating to the planning policy and flood risk management and provides a background to various plans, strategies, policies, and assessments that are relevant to the LCRCA.

B Appendix B - Interactive GeoPDF SFRA 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 the constituent authority boundaries; clicking within an authority boundary will open up the Index Map covering that authority.

The Index Map includes a set of grid squares; clicking on a grid square will open the Detailed Map of that grid square.

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.

C Appendix C - Functional floodplain delineation

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

D Appendix D - Climate change modelling inventory and technical note

Inventory and technical modelling note of EA fluvial and tidal hydraulic models that have been updated with the latest climate change allowances in the SFRA.

E Appendix E - North-West SuDS Pro-forma

This pro-forma is a requirement for any planning application for major development in the North-West of England. It supports applicants in summarising and confirming how surface water from a development will be managed sustainably under current and future conditions

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