Level 1 Strategic Flood Risk Assessment for Greater Manchester - Update

Final Report

March 2019

GMCA GREATER MANCHESTER COMBINED AUTHORITY

Manchester City Council

Town Hall

Albert Square

Manchester

M60 2LA

JBA Project Manager

Mike Williamson
JBA Consulting
Mersey Bank House
Barbauld Street
Warrington
WA1 1WA

Revision History

Revision Ref / Date Issued	Amendments	Issued to
V1.0 / March 2019 / Draft	GMCA comments	Alex McDyre
V1.0 / March 2019 / Final	Additional GMCA comments	Alex McDyre

Contract

This report describes work commissioned by David Hodcroft, on behalf of Greater Manchester Combined Authority Planning and Housing Team, by email dated 28 August 2018. The lead representative for the contract was David Hodcroft. Mike Williamson of JBA Consulting carried out this work.

Prepared by ..... Mike Williamson BSc MSc EADA FRGS CGeog
Principal Flood Risk Analyst

Reviewed by ..... Rachel Brisley BA Dip TRP MCD MBA AMBA
Associate Director

Purpose

This document has been prepared as a Final Report for Greater Manchester Combined Authority. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to Greater Manchester Combined Authority.

Acknowledgements

JBA would like to thank all Greater Manchester Combined Authority, all Greater Manchester local authorities, Environment Agency, United Utilities and Natural England staff for their time and commitment to providing data and discussing the issues identified during the course of this study.

Copyright

Carbon Footprint

A printed copy of the main text in this document will result in a carbon footprint of 503g if 100% post-consumer recycled paper is used and 640g if primary-source paper is used. These figures assume the report is printed in black and white on A4 paper and in duplex.

JBA is aiming to reduce its per capita carbon emissions.

Executive Summary

Greater Manchester Combined Authority (GMCA) commissioned JBA Consulting by email dated 28 August 2018 for the undertaking of an update to the Level 1 Strategic Flood Risk Assessment (SFRA) and Strategic Flood Risk Management Framework (SFRMF) to cover the ten Greater Manchester (GM) councils that make up GMCA.

GMCA requires this updated Level 1 SFRA and SFRMF to support the Greater Manchester Spatial Framework (GMSF). This commission updates the original SFRA and SFRMF, completed in August 2018. It accounts for updates to the Greater Manchester Spatial Framework (GMSF) allocations and each of the ten GM district council's land supply sites for housing, office space and industrial / warehousing space.

GMCA is acting on behalf of each of the ten councils; these are all designated Lead Local Flood Authorities (LLFA) as well as LPAs.

In August 2014, the ten Local Planning Authorities (LPA) in GM agreed to prepare a joint Development Plan Document to set out the approach to housing and employment growth for the next 20 years. This is known as the GMSF (2019).

This SFRA is required to:

- **initiate the sequential risk-based approach to the allocation of land for development and**
- **identify whether application of the Exception Test is likely to be necessary using the most up-to-date information and guidance.**

This will help to inform and provide the evidence base for the GMSF and each individual council's local plan.

The SFRA has been carried out in accordance with Government's latest development planning guidance, namely:

- the revised National Planning Policy Framework[1] (NPPF) (updated February 2019) and

1 National Planning Policy Framework

- the flood risk and planning guidance the Flood Risk and Coastal Change Planning Practice Guidance[2] (FRCC-PPG) (last updated March 2014, at the time of writing).

The commission consists of three phases:

1. Existing and future flood risk screening of potential development sites under the following categories:
    a. GMSF allocations (2019);
    b. Baseline land supply (2018);
    c. Call for sites (2018).
2. Level 1 SFRA as per the requirements set out in the NPPF and FRCC-PPG;
3. Strategic Flood Risk Management Framework - GMCA requires a spatial framework to manage flood risk and development in GM. This will be used to set out the most significant areas of flood risk at the GMCA level.

    It will include for cross-boundary issues within and outside GMCA and recommend key priorities for intervention taking account of previous, existing and planned interventions delivered or to be delivered by all Risk Management Authorities (RMAs).

    The Framework will be informed by a review of relevant strategies, FRM governance and flood risk funding mechanisms. The SFRMF will be informed by this SFRA and in turn will inform the development of the GMSF.

Phase's 1 and 2 outcomes

Development viability assessments for all potential sites are summarised through a number of strategic recommendations (see

The outcomes of phase's 1 and 2, based on existing risk, are summarised in

Table 1-1 to Table 1-3. The effects of climate change on future development has also been assessed and is discussed in Sections 6.9, 7.2.2 and 7.3.3 of this report.). These are formulated from strategic assessments of flood risk and

2 Flood Risk and Coastal Change Planning Practice Guidance

development vulnerability. The results of these assessments are included within Appendix B and C.

The strategic recommendations broadly entail the following:

- Strategic Recommendation A - consider withdrawal of site if development cannot take place outside of Flood Zone 3b;
- Strategic Recommendation B - Exception Test required if site passes Sequential Test;
- Strategic Recommendation C - consider site layout and design around the identified flood risk if site passes Sequential Test, as part of a detailed FRA or drainage strategy;
- Strategic Recommendation D - site-specific FRA required; and
- Strategic Recommendation E - site permitted on flood risk grounds due to little perceived risk, subject to consultation with the LPA / LLFA.

The outcomes of phase's 1 and 2, based on existing risk, are summarised in Table 1-1 to Table 1-3. The effects of climate change on future development has also been assessed and is discussed in Sections 6.9, 7.2.2 and 7.3.3 of this report.

Table 1-1: Summary of strategic recommendations for GM allocations (2019)

	Number of strategic recommendations applied				
Authority	**A**	**B**	**C**	**D**	**E**
Bolton	0	0	1	2	0
Bury*	0	0	3	3	0
Manchester	0	0	1	2	0
Oldham^	0	2	5	10	0
Rochdale^*	1	1	5	6	0
Salford	1	0	0	3	0
Stockport	0	0	2	6	0
Tameside	0	0	1	3	0
Trafford	0	0	2	0	0
Wigan	0	0	4	1	0
GM	**2**	**3**	**24**	**36**	**0**

^Two sites overlap between Oldham and Rochdale

*Two sites overlap between Rochdale and Bury

- Only two allocations are recommended for withdrawal if development cannot take place outside of FZ3b, based on the proportion of the site areas being within the functional floodplain. These allocations are in Rochdale and Salford.
- Three allocations will have to be subject to and pass the Exception Test if the site boundaries cannot be altered to remove the high risk areas. Two of these sites are in Oldham and one is in Rochdale.
- These five sites should be further investigated by the LPA and LLFA to ascertain developability.
- 24 allocated sites require careful consideration of site design and layout with regards to avoiding or accommodating the flood risk. This should take place as part of a detailed site-specific FRA and drainage strategy used to inform the design and layout of the proposed site.

Table 1-2: Summary of strategic recommendations to baseline land supply (2018) sites

	Number of strategic recommendations applied				
Authority	**A**	**B**	**C**	**D**	**E**
Bolton	2	9	44	215	131
Bury	3	5	29	84	83
Manchester	3	9	53	281	272
Oldham	1	4	62	225	154
Rochdale	7	18	43	141	110
Salford	0	17	36	156	93
Stockport	2	5	31	197	176
Tameside	3	7	29	134	81
Trafford	1	4	23	211	105
Wigan	5	13	50	196	156
GM	**27**	**91**	**400**	**1840**	**1361**

- The majority of the baseline land supply sites, in Table 7-7, will require site-specific FRAs as a minimum (Strategic Recommendation D).
- Many sites are also at very low risk and may not require any further assessment of flood risk (Strategic Recommendation E), though this is at the discretion of the LPA.
- 27 land supply sites are recommended for withdrawal if the functional floodplain cannot be avoided, the majority being in Rochdale followed by Wigan. No land supply sites in Salford are recommended for withdrawal.
- 91 sites will require the undertaking and passing of the Exception Test if development is to be permitted. Most of these sites are in Rochdale, Salford and Wigan.

Table 1-3: Summary of strategic recommendations for call for sites (2018) sites

	Number of strategic recommendations applied				
Authority	**A**	**B**	**C**	**D**	**E**
Bolton	2	1	32	90	4
Bury	4	1	32	92	2
Manchester	2	2	13	24	11
Oldham	1	8	45	83	11
Rochdale	11	4	38	79	4
Salford	1	4	18	30	1
Stockport	6	3	53	208	27
Tameside	4	1	22	82	5
Trafford	6	2	21	41	2
Wigan	10	2	32	83	4
GM	**47**	**28**	**306**	**812**	**71**

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

- Detailed interactive GeoPDF maps showing all available flood risk information together with the potential development sites - Appendix A;
- Development Site Assessment spreadsheets for each council detailing the risk to each potential development site with subsequent strategic recommendations on development - Appendix B;
- Site assessment summary reports for each council, detailing the assessment process, outcomes and subsequent strategic recommendations – Appendix C;
- Functional floodplain delineation notes for each council – methodology note on how the functional floodplain has been defined – Appendix D;
- Climate change modelled watercourses – list of GM watercourses which have been modelled for climate change – Appendix E; and
- Sustainable Drainage Systems (SuDS) selection summary – documentation on various available SuDS techniques (Appendix F1) and SuDS suitability for GM (Appendix F2) – Appendix F.

Contents

Contents

Contents

List of Figures

List of Tables

Abbreviations

ABD ..... Areas Benefitting from Defences

ACDP ..... Area with Critical Drainage Problems

AEP ..... Annual Exceedance Probability

AStGWF ..... Areas Susceptible to Groundwater Flooding

CaBA ..... Catchment Based Approach

CC ..... Climate change

CCA..... Civil Contingencies Act

CDA..... Critical Drainage Area

CFMP ..... Catchment Flood Management Plan

CIL..... Community Infrastructure Levy

CSO..... Combined Sewer Overflow

DAZ ..... Drainage Area Zone

DCLG ..... Department for Communities and Local Government

DPD..... Development Plan Documents

DTM..... Digital Terrain Model

EA..... Environment Agency

FAA ..... Flood Alert Area

FCA ..... Flood Consequence Assessment

FCDPAG ..... Flood and Coastal Defence Project Appraisal Guidance

FCERM..... Flood and Coastal Erosion Risk Management Network

FDGiA..... Flood Defence Grant in Aid

FEH ..... Flood Estimation Handbook

FMP..... Flood Map for Planning (Rivers and Sea)

FRA ..... Flood Risk Assessment

FRCC-PPG..... Flood Risk and Coastal Change Planning Practice Guidance

FRM..... Flood Risk Management

FRMP ..... Flood Risk Management Plan

FRMS ..... Flood Risk Management Strategy

FRR ..... Flood Risk Regulations

FSA ..... Flood Storage Area

FWA ..... Flood Warning Area

FWMA ..... Flood and Water Management Act

GI..... Green Infrastructure

GIS ..... Geographical Information Systems

GM..... Greater Manchester

GMCA..... Greater Manchester Combined Authority

GMSF ..... Greater Manchester Spatial Framework

HFM..... Historic Flood Map

IDB ..... Internal Drainage Board

LA ..... Local Authority

LASOO ..... Local Authority SuDS Office Organisation

LDF..... Local Development Framework

LFRMS ..... Local Flood Risk Management Strategy

LLFA..... Lead Local Flood Authority

LPA..... Local Planning Authority

LRF..... Local Resilience Forum

MAFRP ..... Multi-Agency Flood Response Plan

MBC ..... Metropolitan Borough Council

MHCLG ..... Ministry of Housing, Communities and Local Government

MSC ..... Manchester Ship Canal

NFM..... Natural Flood Management

NGO ..... Non-Governmental Organisation

NPPF..... National Planning Policy Framework

OAFCDM ..... Opportunity Area for Further Critical Drainage Management

PCPA..... Planning and Compulsory Purchase Act

PFRA..... Preliminary Flood Risk Assessment

RBD..... River Basin District

RBMP ..... River Basin Management Plan

RFCC ..... Regional Flood and Coastal Committee

RFM..... Reservoir Flood Map

RFO..... Recorded Flood Outlines

RoFSW..... Risk of Flooding from Surface Water map

RMA ..... Risk Management Authority

RoFRS..... Risk of Flooding from Rivers and the Sea Map

SA..... Sustainability Appraisal

SEA ..... Strategic Environmental Assessment

SFRMF ..... Strategic Flood Risk Management Framework

SFRA..... Strategic Flood Risk Assessment

SHLAA..... Strategic Housing Land Availability Assessment

SoP..... Standard of Protection

SPD ..... Supplementary Planning Documents

SuDS ..... Sustainable Drainage Systems

SWMP ..... Surface Water Management Plan

UDP..... Unitary Development Plan

UKCP09 ..... UK Climate Projections 2009

UKCP18 ..... UK Climate Projections 2018

UU ..... United Utilities

WCS ..... Water Cycle Study

WFD ..... Water Framework Directive

WwNP ..... Working with Natural Processes

1 Introduction

1.1 Commission

Greater Manchester Combined Authority (GMCA) commissioned JBA Consulting by email dated 28 August 2018 for the undertaking of an update to the Level 1 Strategic Flood Risk Assessment (SFRA) and Strategic Flood Risk Management Framework (SFRMF) to cover the ten Greater Manchester (GM) councils that make up GMCA.

GMCA requires this updated Level 1 SFRA and SFRMF to support the Greater Manchester Spatial Framework (GMSF). This commission updates the original SFRA and SFRMF, completed in August 2018, to account for updates to the Greater Manchester Spatial Framework (GMSF) allocations and each of the ten GM district council's land supply sites for housing, office space and industrial / warehousing space.

GMCA is acting on behalf of each of the ten councils; these are all designated Lead Local Flood Authorities (LLFA) as well as LPAs.

1.2 Greater Manchester Spatial Framework (GMSF)

In August 2014, the ten Local Planning Authorities (LPA) in GM agreed to prepare a joint Development Plan Document to set out the approach to housing and employment growth for the next 20 years. This is known as the GMSF (2019). The GMSF will:

- Set out how Greater Manchester should develop over the next two decades up to the year 2035;
- Identify the amount of new development that will come forward across the ten districts, in terms of housing, offices, and industry and warehousing, and the main areas in which this will be focused;
- Support the delivery of key infrastructure, such as transport and utilities;
- Protect important environment assets across the conurbation;
- Allocate sites for employment and housing outside the urban area;
- Define a new Green Belt boundary for Greater Manchester.

This Level 1 SFRA and the SFRMF will inform and support the continuing development of the GMSF. The GMSF is described in more detail in Section 5.

1.3 GMCA Level 1 SFRA

This SFRA is required to

- **initiate the sequential risk-based approach to the allocation of land for development and**
- **identify whether application of the Exception Test is likely to be necessary using the most up-to-date information and guidance.**

This will help to inform and provide the evidence base for the GMSF and each individual council's local plans.

This SFRA has been carried out in accordance with Government's latest development planning guidance including:

- the National Planning Policy Framework (NPPF) and
- flood risk and planning guidance called the Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG).

The latest guidance, at the time of writing, is available online via:

Flood Risk and Coastal Change Planning Practice Guidance

A revised version of the NPPF was published on 24 July 2018 with a further revision released on 19 February 2019, setting out Government's planning policies for England and how these are expected to be applied. The revised Framework replaces the original NPPF first published in March 2012 and can be viewed online or downloaded via:

National Planning Policy Framework

This SFRA assesses the spatial distribution of current and future flood risk across GM. It provides the discussion and guidance required to put this information into practice when taking account of flood risk in development plans and the level of detail required for site specific Flood Risk Assessments (FRA).

The original Level 1 SFRA for GM, which was the first SFRA to cover all of GM, was completed in 2008. Since that time a number of Level 1 and Level 2 SFRAs have been prepared by individual or groups of GM LPAs.

The 2018 GMCA SFRA updated all the individual SFRAs, using the most up-to-date flood risk datasets, at the time of submission. It assessed the extent of risk, at a strategic level, to potential development allocations, existing land supply sites and other Green Belt sites suggested for development by landowners and developers.

This 2019 update accounts for updates to the GMSF allocated sites and each council's land supply sites. There have not been any updates to the flood risk data since the 2018 SFRA was completed in August 2018.

As per the Project Brief, the Level 1 SFRA is split into three phases of work:

1.3.1 Phase 1 - screening of potential development sites

GMCA provided several GIS datasets containing the following potential development sites information:

- Revised Draft GMSF allocations. These sites are the proposed site allocations within the Revised Draft GMSF for 2019. These sites are in Green Belt and are proposed to be removed from Green Belt and allocated for development in the GMSF. They are the sites that are needed to meet the shortfall in housing and employment land needs up to 2037.
- 2018 GM baseline housing, industry and warehousing and office land supply, which show the potential supply of new housing and employment land for each GM council up to 31 March 2037.
- 2018 GMSF Call for Sites Submissions. A Greater Manchester-wide call for sites exercise was completed in 2018. The purpose of the exercise was to identify through a transparent and open process, potential sites that could be technically assessed for their suitability, availability, and achievability (including viability) for housing and economic development to meet development needs.

  Sites can be put forward by anyone or any organisation and typically have been promoted by land owners, developers, agents, local businesses.

residents. This information was then used to identify whether there are areas of land available for development that individual districts or GMCA were not aware of. The sites have not been endorsed by the GMCA or the individual districts and they have no formal planning status. These sites are currently in Green Belt though developers and landowners have suggested they should be taken out of Green Belt and allocated for development through the GMSF. However, the majority of these sites are not proposed for allocation in the GMSF.

Approximately, 5,600 potential development sites are assessed, using GIS software, to screen all sites against the Environment Agency's (EA) Flood Map for Planning (Flood Zones 2 and 3), the functional floodplain (Flood Zone 3b), fluvial climate change (based on the EA's February 2016 allowances) and the surface water flood zones of the EA's Risk of Flooding from Surface Water (RoFSW) dataset. All sites are also screened against the EA's Working with Natural Processes (WwNP) datasets (see Section 6.8.5) and Rivers Trust Irwell Catchment project to gauge the potential of sites for future flood storage functions to support Natural Flood Management (NFM).

NOTE: further potential development sites may come forward at some stage in the future that will require assessment against flood risk. Were this to be the case, this SFRA will be updated with the new sites information.

The screening of sites and allocations will enable GMCA to:

- Demonstrate that the most up-to-date flood risk information has been used to determine the suitability of potential housing and employment development sites in GM;
- Undertake the Sequential Test, using the Sites Assessment spreadsheet in Appendix B, and identify sites or allocations that are not suitable for development; or that will need to pass the Exception Test; or that should change development layout or boundaries to avoid risk; or that may be permitted subject to a suitable FRA; or that may be permitted without the requirement for an FRA;

- Identify the existing GM council's housing and employment sites and GMSF allocations which may require a Level 2 SFRA to assess the likelihood of passing the second part of the Exception Test.

The primary output of this work will be the Development Site Assessment spreadsheet (Appendix B). This will identify and summarise the extent to which sites are affected by the flood risk, including a response to the level of flood risk via strategic development viability recommendations. The spreadsheets are split per local authority.

This assessment will enable the LPAs to steer development away from those areas where flood risk is considered greatest. Thus ensuring that areas allocated for development can be developed in a safe, cost effective and sustainable manner.

1.3.2 Phase 2 - Level 1 SFRA

This Level 1 SFRA will use the most up-to-date information to strategically assess flood risk in the conurbation of GM.

The first stream of the Level 1 SFRA, as stated in the Project Brief, will include, but not be limited to, the following:

- A short overview of planning and flood risk legislation, policy (the NPPF (2019) and FRCC-PPG), strategies and good practice, including web links to documents and web pages.
- An overview of current and future flood risk in Greater Manchester - fluvial, surface water, sewer, groundwater and residual risk (canals, reservoirs, defence infrastructure failure), including:
    - The standard of protection provided by existing flood risk management infrastructure
    - A review of historic flooding incidents
    - An overview of asset management including current LLFA asset registers and critical flood risk management infrastructure that may need to be considered for future remedial works and / or replacement

    - A review of the applicability of the spatial nature of the existing GM Critical Drainage Areas (CDAs)
- To present a thorough and updated understanding of flood risk, based on the most up-to-date EA modelling.
- Strategic recommendations on development viability for all sites assessed as an evidence base for the GMSF and local plans (provided as a site summary report for each authority in Appendix C).
- To identify land required for current and future flood risk management that should be safeguarded as set out in the NPPF.
- An overview of the 2016 climate change allowance on river flows and advice on the implications and appropriate responses to manage potential increases in flood risk.
- To adopt a catchment-based approach to flood risk assessment and management to help inform potential catchment-wide approaches and solutions to flood risk management.
- To assist GMCA in identifying specific areas where further and more detailed flood risk data and assessment work may be required.
- To provide guidance for developers and local authority planning officers on planning requirements in relation to flood risk.
- An overview of emergency planning flood risk procedures.
- To provide a reference document (this report) to which all parties involved in development planning and flood risk can reliably turn to for initial advice and guidance.
- To develop a report that forms the basis of an informed development management process that also provides guidance on the potential risk of flooding associated with future planning applications and the basis for site-specific FRAs where necessary.

The appendix to this Level 1 SFRA includes:

- interactive GeoPDF Maps (Appendix A) showing the potential development sites overlaid with the latest, readily available flood risk information;

- the Development Site Assessment spreadsheet from Phase 1 (Appendix B);
- site reports summarising the level of flood risk to each site following a strategic assessment (Appendix C);
- technical methodology notes on the updating of the functional floodplain for GM (Appendix D);
- a summary table of the GM watercourses that have been modelled for future risk using the EA's most recent climate change allowances from 2016 (Appendix E); and
- Sustainable Drainage Systems (SuDS) suitability and selection techniques (Appendix F).

1.3.3 Phase 3 - Strategic Flood Risk Management Framework

As per the Project Brief, GMCA requires a spatial framework to manage flood risk and development in GM.

Following discussion with the GM SFRA Steering Group, it has been agreed that this should take the form of a Strategic Framework. This will be used to set out the most significant areas of flood risk at the GMCA level including cross-boundary issues within and outside GMCA.

It will recommend key priorities for intervention taking account of previous, existing, and planned interventions delivered or to be delivered by all Risk Management Authorities (RMAs). The Framework will be informed by a review of relevant strategies, FRM governance and flood risk funding mechanisms.

The SFRMF will be informed by this Level 1 SFRA and in turn will inform the development of the GMSF.

1.4 SFRA future proofing

This SFRA has been developed using the most up-to-date data and information available at the time of submission.

This SFRA has been future proofed as far as possible though the reader should always confirm with the source organisation (GMCA) 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 primary development and flood risk guidance information available at the time of the finalisation of this SFRA.

The EA would usually recommend updating an SFRA every three to four years, unless there is a significant flood affecting the area or a change in policy, in which case an immediate review should be undertaken.

As discussed, this SFRA will be updated as and when new potential development sites come forward that are required to be assessed against flood risk. **This SFRA therefore remains a 'live document' that can be updated at any time.**

This SFRA uses the EA's Flood Map for Planning version issued in February 2018 to assess fluvial risk to potential development sites.

The Flood Map for Planning is updated at quarterly intervals by the EA, as and when new modelling data becomes available. The reader should therefore refer to the online version of the Flood Map for Planning to check whether the flood zones may have been updated since February 2018, via the following link:

Flood Map for Planning

2 Study area

GM is one of the country's most successful city-regions. It is home to more than 2.7 million people and with an economy bigger than that of Wales or Northern Ireland.

The GMCA is made up of the ten GM councils and Mayor, who work with other local services, businesses, communities, and other partners to improve the city-region. The ten councils (Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford and Wigan) have worked together voluntarily for many years on key issues for the region such as transport, regeneration, and inward investment.

As can be seen in Figure 2-1, there is a large network of main rivers running through GM. There are also many canals, such as the Manchester Ship Canal (MSC), and ordinary watercourses (generally smaller scale watercourses than main rivers) flowing through the conurbation.

The hydrology of GM is influenced by natural variations in topography and geology and by man-made factors such as canals, reservoirs, and large urbanised areas. As a result, its hydrology is complex with multiple sources of flood risk.

Reservoirs in the Tame, Goyt and Etherow catchments have an influence on flows within the catchments, particularly in the upper reaches. The MSC receives waters from both the Upper Mersey and River Irwell catchments and provides an important drainage and flood alleviation function.

Many large watercourses in GM have been culverted and/or diverted, such as parts of the River Medlock, River Irk and Corn Brook. This was mainly to accommodate the large-scale rapid development phase of the industrial revolution.

There are many unknown watercourses that flow through old culverts and tunnels beneath Manchester City Centre with the condition and exact route of such underground conduits unknown. This lack of knowledge can present a potential flood risk to local areas. A lot of work is being undertaken to map and to better understand these hidden watercourses.

Several watercourses flow into GM from outside the GM boundary whilst several also flow out of GM into neighbouring authority areas downstream. The River Irwell for example rises in Rossendale to the north before flowing southwards through Bury before entering Bolton district and then Salford district. It then deposits into the MSC on the boundary of Salford and Manchester. Bolton and Salford districts also have many other main rivers and tributaries.

The River Roch rises in the uplands of Rochdale, north of Littleborough, and flows directly through the town of Rochdale before entering the Irwell near Radcliffe in Bury district.

Other notable main rivers include the River Tame, which is a tributary to the River Mersey in Stockport having risen at New Years Bridge Reservoir in Denshaw, Oldham and flowed south through Tameside and into Stockport.

The River Goyt rises in the Peak District, near Buxton, to the south east of Stockport before flowing generally north westerly into the Mersey at Stockport. The Mersey flows through Manchester district to the south of Didsbury.

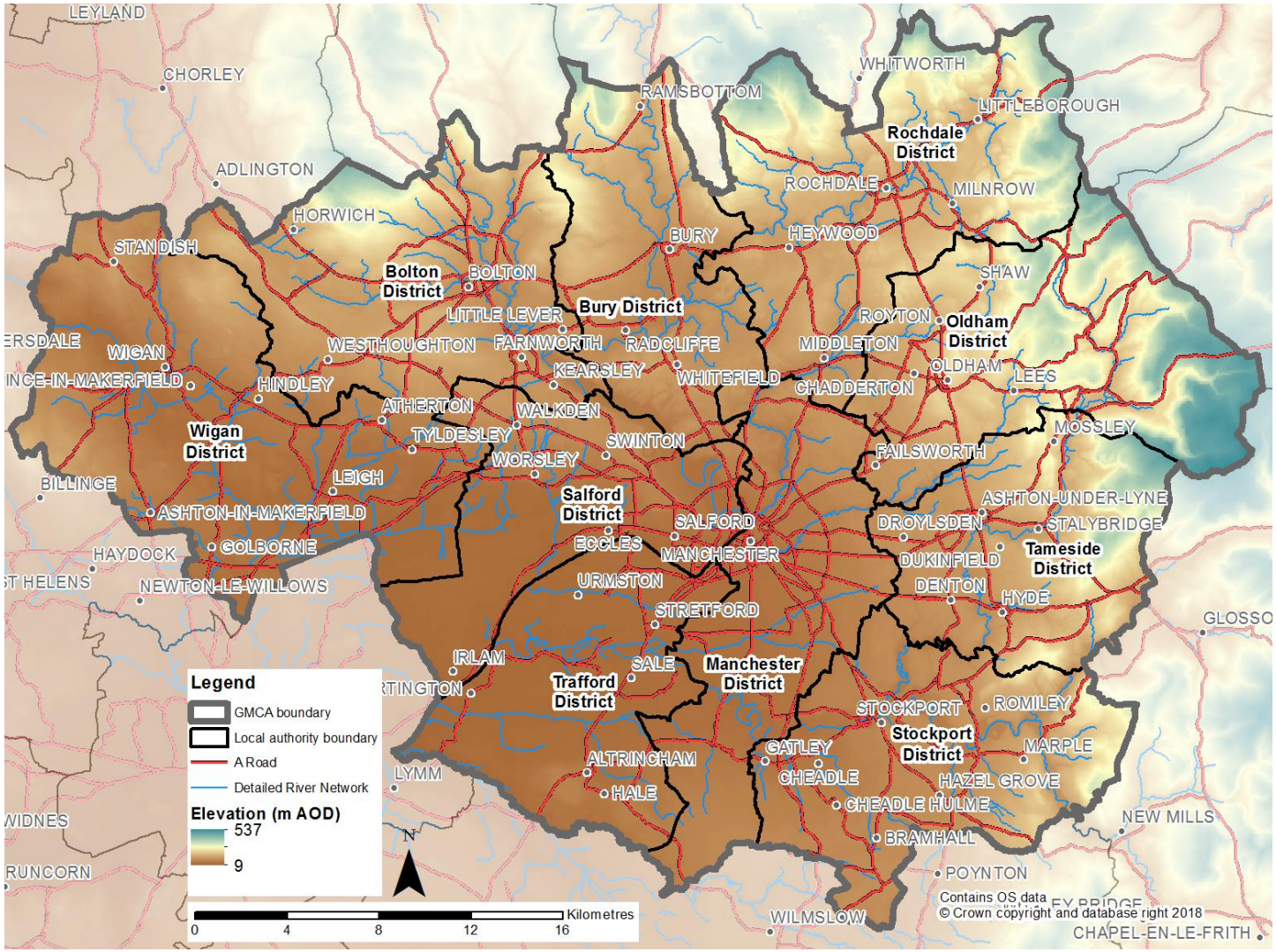
Gore Brook and Cringle Brook also flow westerly through south Manchester and into the Mersey and the River Medlock flows through the city centre before entering the Ship Canal.

The Mersey carries on west through Trafford district before exiting GM into Warrington. The River Bollin form the southern boundary of Trafford to Cheshire East. In Wigan there are numerous main rivers that act as tributaries.

Just over half of GM is urban and serviced by urban drainage systems. This is based on the spatial coverage of United Utilities' (UU) Drainage Area Zones (DAZ). There are 176 UU DAZ's draining the urban areas of GM totalling around 68,140 hectares.

There is a risk of localised flooding associated with the drainage infrastructure of the urban areas due, in part, to undersized existing drainage capacity and sewer systems and possible blockages of the network. UU is responsible for the management of the adopted sewerage system, including surface water and foul sewerage. Section 6.4 includes information on surface water flood risk in GM.

Figure 2-1: SFRA study area



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 people and human or environmental assets are present in the area that floods.

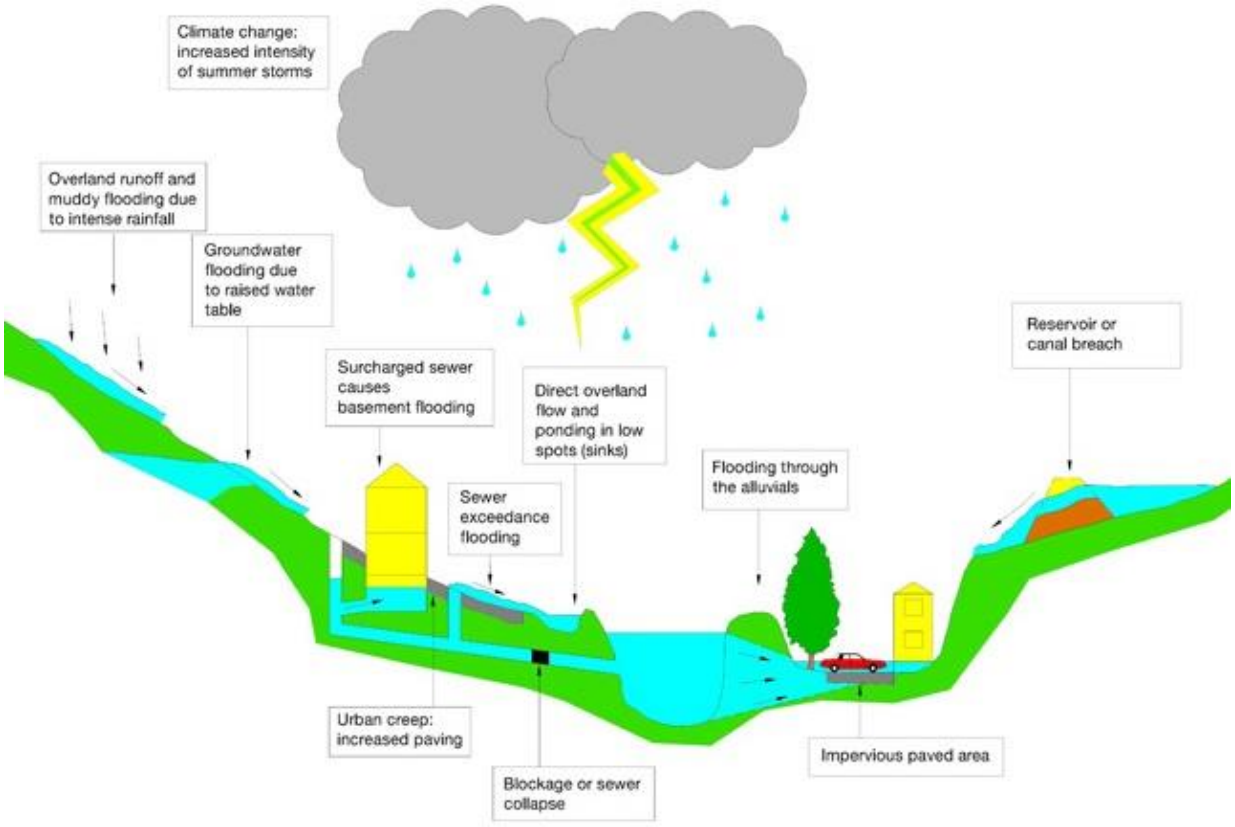
Assets at risk from flooding can include housing, transport and public service infrastructure, commercial and industrial enterprises, agricultural land, and environmental and cultural heritage.

Flooding can occur from many different and combined sources and in many ways. Major sources of flooding (also see Figure 3-1) include:

- **Fluvial** (main rivers and ordinary watercourses) –
    - inundation of floodplains from rivers and watercourses;
    - inundation of areas outside the floodplain due to influence of bridges, embankments and other features that artificially raise water levels;
    - overtopping or breaching of defences; blockages of culverts;
    - blockages of flood channels/corridors.
- **Tidal** (not applicable to GMCA) - sea; estuary; overtopping of defences; breaching of defences; other flows (e.g. fluvial surface water) that could pond due to tide locking; wave action.
- **Surface water** - surface water flooding covers two main sources including direct run-off from adjacent land (pluvial) and surcharging of piped drainage systems (public sewers, highway drains, etc.)
- **Groundwater** - water table rising after prolonged rainfall to emerge above ground level remote from a watercourse; most likely to occur in low-lying areas underlain by permeable rock (aquifers); groundwater recovery after pumping for mining or industry has ceased.
- **Infrastructure failure** - reservoirs; canals; industrial processes; burst water mains; blocked sewers or failed pumping stations.

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

Figure 3-1: Flooding from all sources

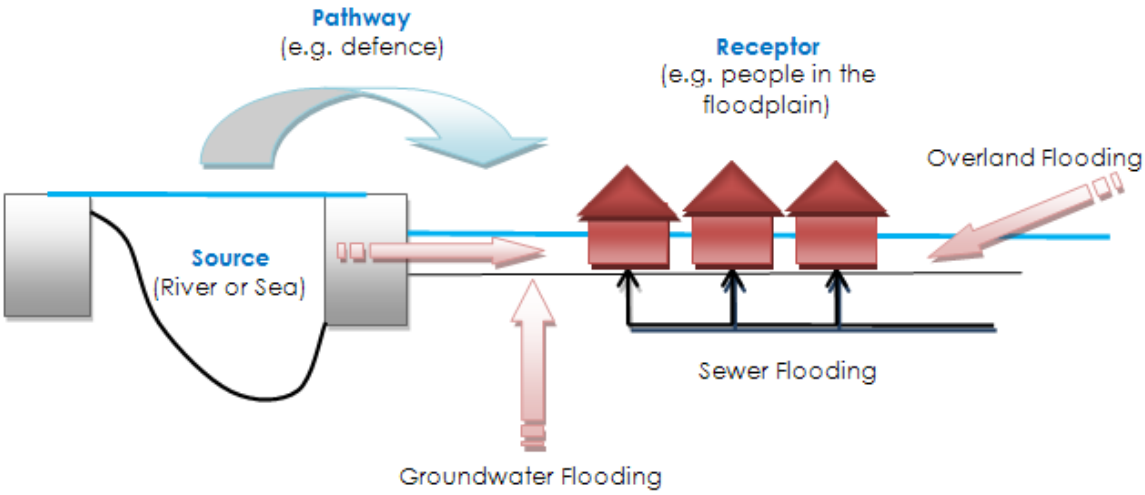


3.2 Likelihood and consequence

Flood risk is a combination of the likelihood of flooding and the potential consequences arising. It is assessed using the source – pathway – receptor model as shown in Figure 3-2 below.

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

Figure 3-2: Source-Pathway-Receptor Model



The principal sources are rainfall or higher than normal sea levels, the most common pathways are rivers, drains, sewers, overland flow and river and coastal floodplains and their defence assets and the receptors can include people, their property, and the environment.

All three elements must be present for flood risk to arise. Mitigation measures have little or no effect on sources of flooding, but they can block or impede pathways or remove receptors.

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

3.2.1 Likelihood

Likelihood of flooding is expressed as the percentage probability based on the average frequency measured or extrapolated from records over many years. A 1% probability indicates the flood level that is expected to be reached on average once in a hundred years, i.e. it has a 1% chance of occurring in any one year, not that it will occur once every hundred years.

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

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

The Flood Map for Planning can be accessed via: Flood Map for Planning

Table 3-1: FRCC-PPG Flood Zones[3]

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	**This zone comprises land where water has to flow or be stored in times of flood.** Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

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

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

- A 1 in 100 (1%) annual probability flood has a 1 in 4 (26%) chance of occurring at least once in a 30-year period - the period of a typical residential mortgage
- And a 1 in 2 (49%) chance of occurring in a 70-year period - a typical human lifetime

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,
- wave-action effects,
- water quality

and the vulnerability of receptors:

- type of development,
- nature, e.g. age-structure, of the population,
- presence and reliability of mitigation measures etc.

Flood risk is then expressed in terms of the following relationship:

Flood risk = Probability of flooding x Consequences of flooding

3.3 Risk

Flood risk is not static; it cannot be described simply as a fixed water level that will occur if a river overtops its banks or from a high spring tide that coincides with a storm surge. It is therefore important to consider the continuum of risk carefully.

Risk varies depending on the severity of the event, the source of the water, the pathways of flooding (such as the condition of flood defences) and the vulnerability of receptors as mentioned above.

3.3.1 Actual risk

This is the risk 'as is' 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.

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

3.3.2 Residual risk

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

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

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

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

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

Even when flood defences are in place, there is always a likelihood that these could be overtopped in an extreme event or that they could fail or breach. Where there is a consequence to that occurrence, this risk is known as residual risk.

Defence failure can lead to rapid inundation of fast flowing and deep floodwaters, with significant consequences to people, property, and the local environment behind the defence.

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

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

"Where residual risk is relatively uniform, such as within a large area protected by embanked flood defences, the Strategic Flood Risk Assessment should indicate the nature and severity of the risk remaining, and provide guidance for residual

risk issues to be covered in site-specific flood risk assessments. Where necessary, local planning authorities should use information on identified residual risk to state in Local Plan policies their preferred mitigation strategy in relation to urban form, risk management and where flood mitigation measures are likely to have wider sustainable design implications".

4 The planning framework and flood risk policy

4.1 Introduction

The main purpose of this section of the SFRA is to provide an overview of the key planning and flood risk policy documents and legislation that have shaped the current planning framework.

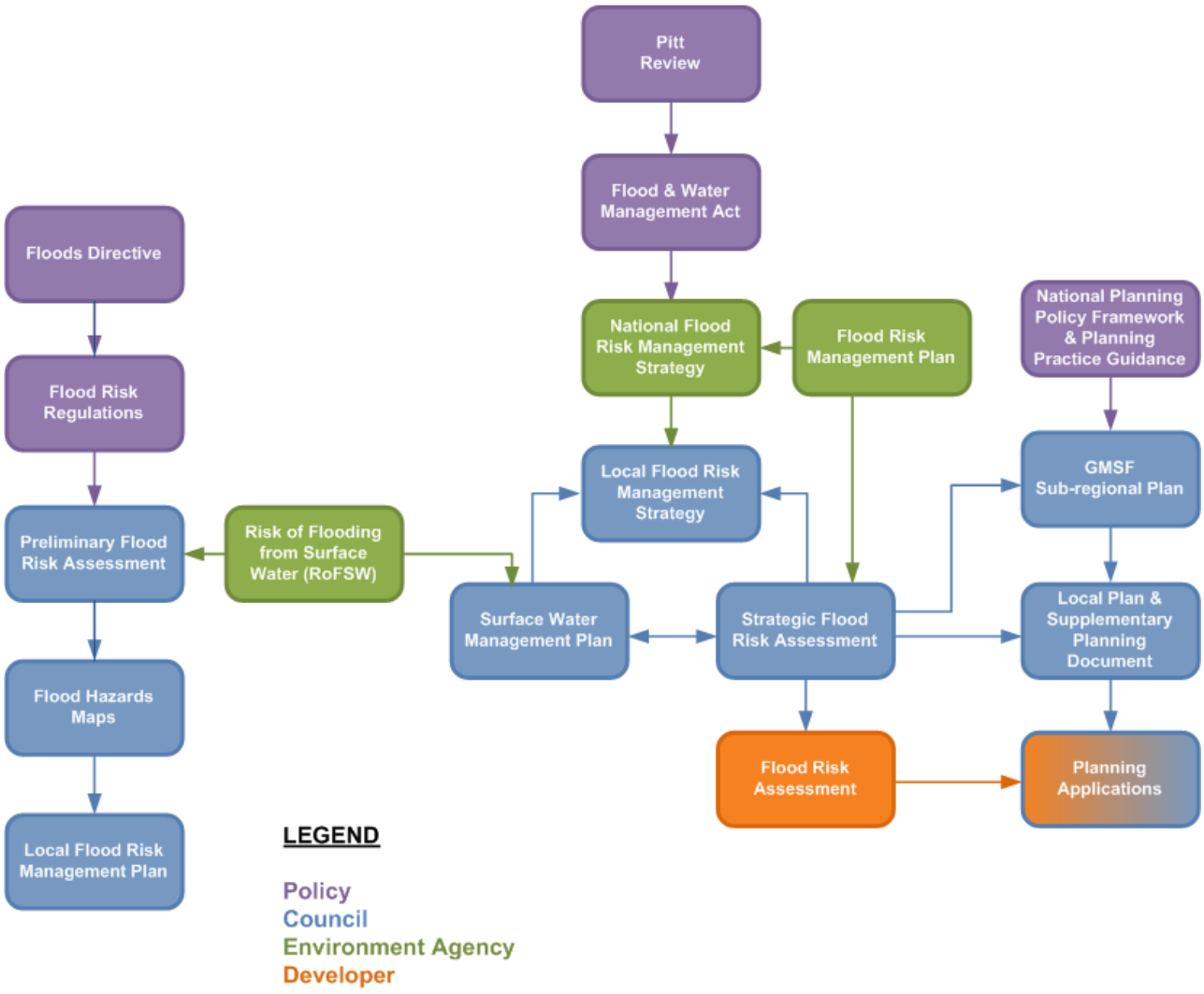
This section also provides an overview and context of the LLFA's and LPA's responsibilities and duties in respect to managing local flood risk. This includes but is not exclusive to the delivery of the requirements of the Flood Risk Regulations (FRR) 2009 and the Flood and Water Management Act (FWMA) 2010.

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

It is intended that the non-statutory SWMPs and SFRAs can provide much of the base data required to support the delivery of each LLFA's statutory flood risk management tasks.

They should also help support the local authorities in developing capacity, effective working arrangements and in informing the Local Flood Risk Management Strategies (LFRMS), local plans and GMCA's Publication GMSF. This in turn will help deliver flood risk management infrastructure and sustainable new development. This SFRA should be used to support the GMSF and individual local plans to help inform planning decisions.

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



4.2 Legislation

4.2.1 EU Floods Directive & the Flood Risk Regulations

The European Floods Directive (2007) sets out the EU's approach to managing flood risk and aims to improve the management of the risk that floods pose to human health, the environment, cultural heritage, and economic activity.

The Directive was translated into English law by the Flood Risk Regulations which require LLFAs and the EA to produce Preliminary Flood Risk Assessment (PFRAs) and Flood Risk Management Plans (FRMPs).

The Directive puts in place a six year cycle of producing PFRAs with the aim of identifying significant Flood Risk Areas; preparing flood hazard and risk maps; and

preparing FRMPs. The first six year cycle was completed in December 2015 and the second six year cycle began in December 2015.

Figure 4-2: EU Floods Directive

PFRAs should cover the entire LLFA area for local flood risk (focusing on ordinary watercourses, surface water and groundwater flooding).

Where significant Flood Risk Areas are identified using the national approach (and locally reviewed), the LLFA is then required to undertake flood risk hazard mapping and to produce FRMPs, as illustrated in Figure 4-2. FRMPs are also completed for each River Basin District in England and Wales by the EA.

The FRMP should consider objectives for flood risk management (reducing the likelihood and consequences of flooding) and measures to achieve those objectives.

The EA implemented one of the exceptions for creating PFRAs for Main Rivers and coastal flooding for the first PFRA cycle. This was because they already had mapping (i.e. EA Flood Map for Planning (Rivers and Sea), Risk of Flooding from Rivers and Sea Map) and plans (i.e. Catchment Flood Management Plans (CFMPs), Shoreline Management Plans (SMPs)) in place to deal with this.

However, this exemption is not available for the second cycle, and therefore the EA is starting to prepare the necessary preliminary assessment maps and report for the second cycle period 2016-21.

4.2.2 Preliminary Flood Risk Assessments

In 2011, during the first PFRA cycle, the EA, using the EA 'Final PFRA Guidance' and DEFRA's 'Guidance on selecting Flood Risk Areas', identified a total of ten indicative Flood Risk Areas in England. One of these covered a large area of GM, including areas of each of the ten LPAs.

Following this identification by the EA, a strategic PFRA was carried out for all of GM. This was given the geographical nature of the indicative Flood Risk Area, together with separate, more focused PFRAs carried out by each of the ten LLFAs.

In 2017, during the second cycle, the EA, using updated guidance, produced an updated indicative Flood Risk Area to supersede the 2011 version, using the most current data at the time. The 2017 indicative Flood Risk Area is considerably smaller than the 2011 area, covering only a small area of Tameside.

This, at the time, was challenged by GMCA due to the considerable reduction in area, though has since been accepted. GMCA accepted that the PFRA is not used as evidence to inform the planning process, unlike this SFRA. By accepting the reduced indicative Flood Risk Area, there should be no impact on the planning process.

The reduction in area was based on a change in the EA methodology used to define indicative Flood Risk Areas. This included improvements to the national surface water risk map (Risk of Flooding from Surface Water - see Section 6.4.1.1) that includes improved digital terrain modelling and property counting methodology.

The new methodology will have influenced the results of applying the clustering methodology and the LLFAs were also able to contribute local modelling to the national surface water risk map to improve local accuracy.

4.2.3 Catchment Flood Management Plans (CFMPs)

The CFMPs were produced by the EA in 2009 and were designed to establish flood risk management policies that will deliver sustainable flood risk management for the long term. The CFMPs were used by the EA to help direct resources to the areas of greatest risk.

The CFMPs contain useful information about how catchments work, previous flooding, and the sensitivity of the river systems to increased rainfall. The EA used the evidence and previous measures and proposals set out in the CFMPs to help develop FRMPs for River Basin Districts (RBDs).

GM is within the North West RBD and is included within four CFMPs, namely the Irwell[4], Upper Mersey[5], Mersey Estuary[6] and Douglas[7].

4.2.4 Flood Risk Management Plans

Following on from the CFMPs, FRMPs are designed to set out the risk of flooding from rivers, sea, surface water, groundwater and reservoirs, within each RBD. They should detail how RMAs will work with communities to manage flood risk up to 2021 for this cycle.

Both the River Basin Management Plans (RBMP) and FRMPs have been developed by the EA in tandem to ensure that flood defence schemes can provide wider environmental benefits during the same six-year cycle.

Both flood risk management and river basin planning form an important part of a collaborative and integrated approach to catchment planning for water. Each EU member country must produce FRMPs as set out in the EU Floods Directive 2007.

The River Irwell catchment dominates the majority of GM (see Figure 4-3) with the Upper Mersey, Lower Mersey and Douglas catchments draining smaller areas (see Figure 4-3 to Figure 4-6). Policies within the Irwell catchment will therefore have the greatest effect on flood risk within GM, given the large area of GM within it.

The proposed SFRMP reviews the main policies and measures of the FRMP.

The full suite of reports on the North West RBD FRMP (split into six documents), including detail on the River Irwell, Upper and Lower Mersey and Douglas catchments can be accessed via: North West River Basin District Flood Risk Management Plan

4 Irwell Catchment Flood Management Plan

5 Upper Mersey Catchment Flood Management Plan

6 Mersey Estuary Catchment Flood Management Plan

7 Douglas Catchment Flood Management Plan

Figure 4-3: River Irwell catchment (extracted from NW RBD FRMP Part B report)

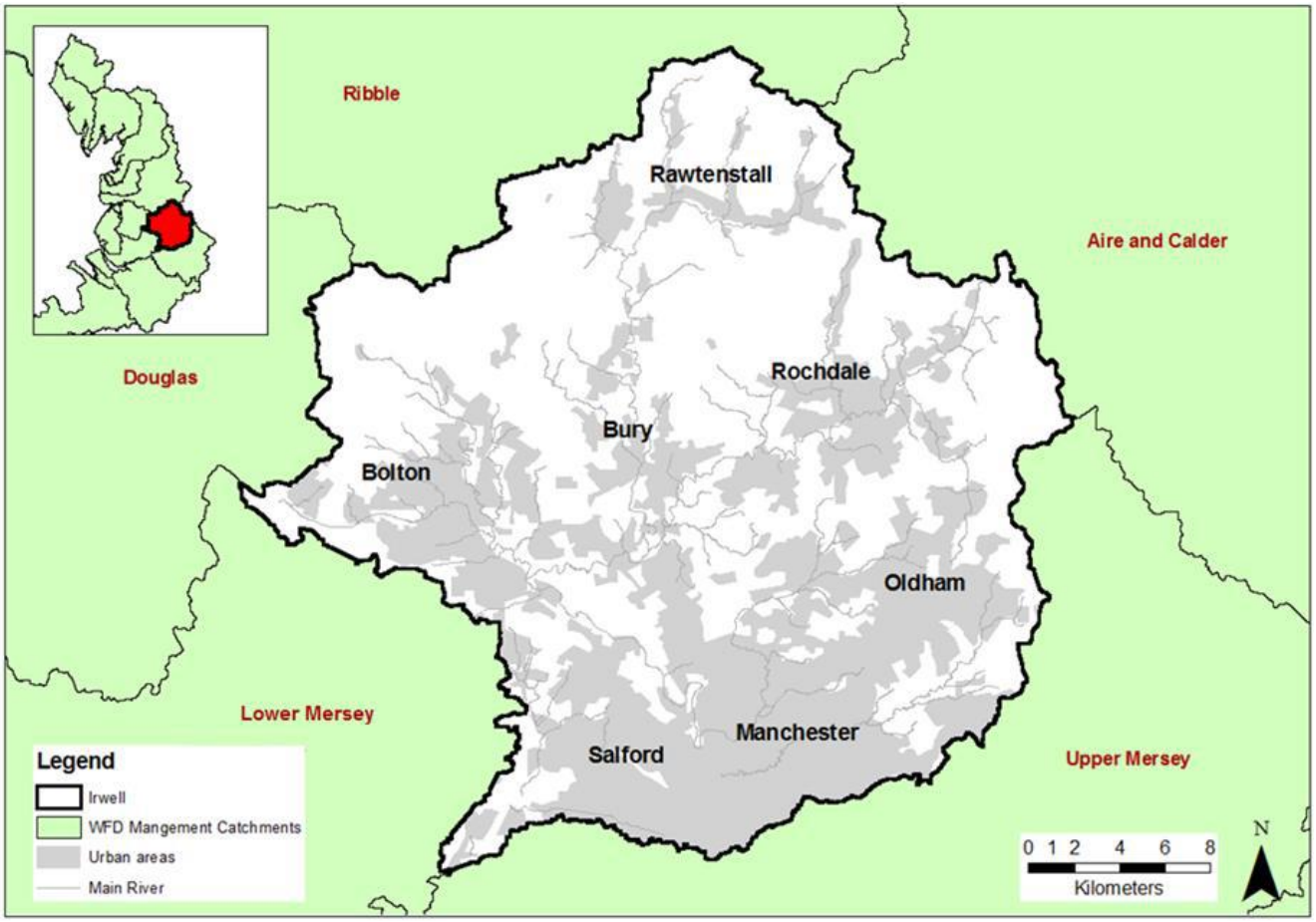


Figure 4-4: Upper Mersey catchment (extracted from NW RBD FRMP Part B report)

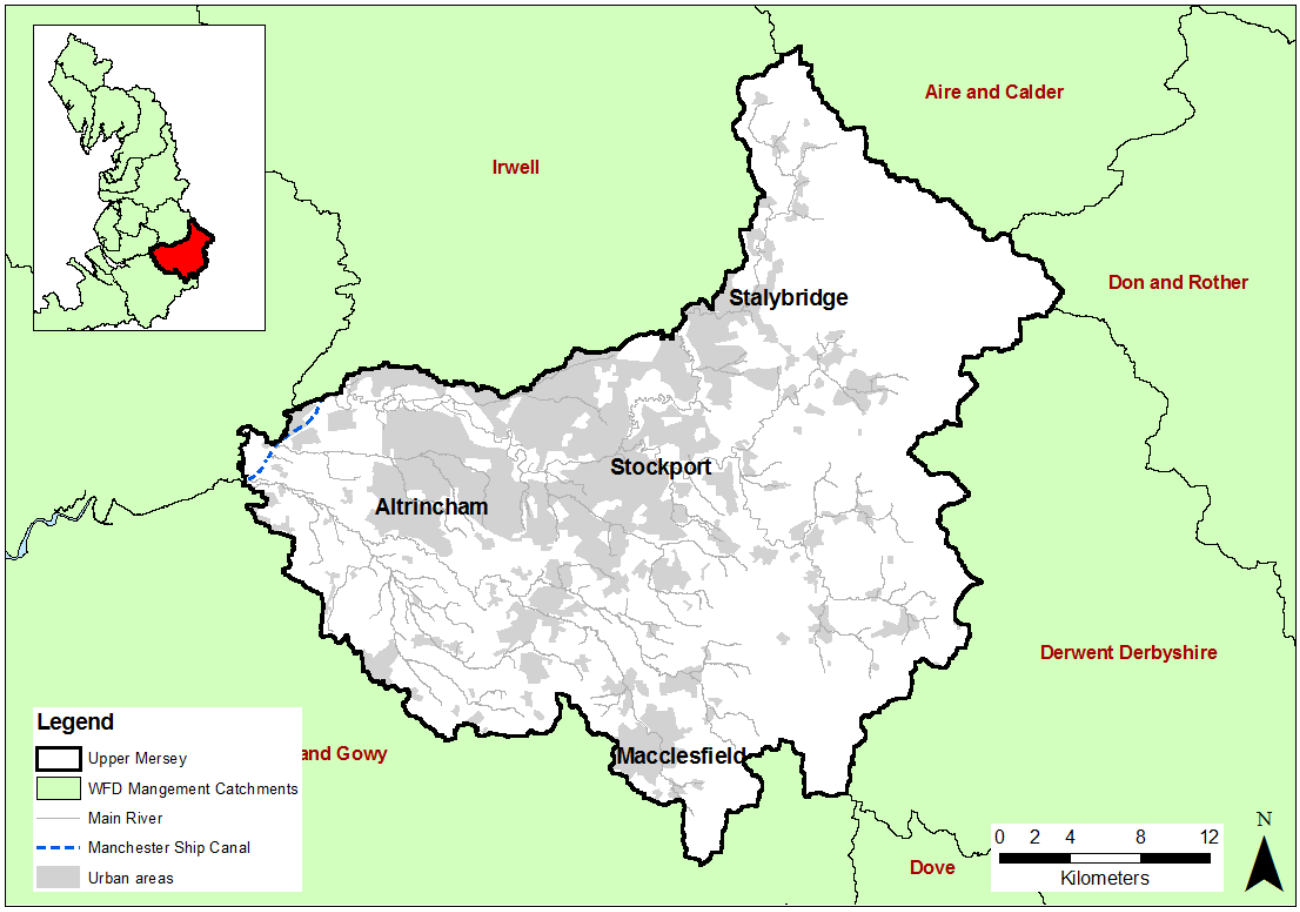


Figure 4-5: Mersey Estuary catchment (extracted from NW RBD FRMP Part B report)

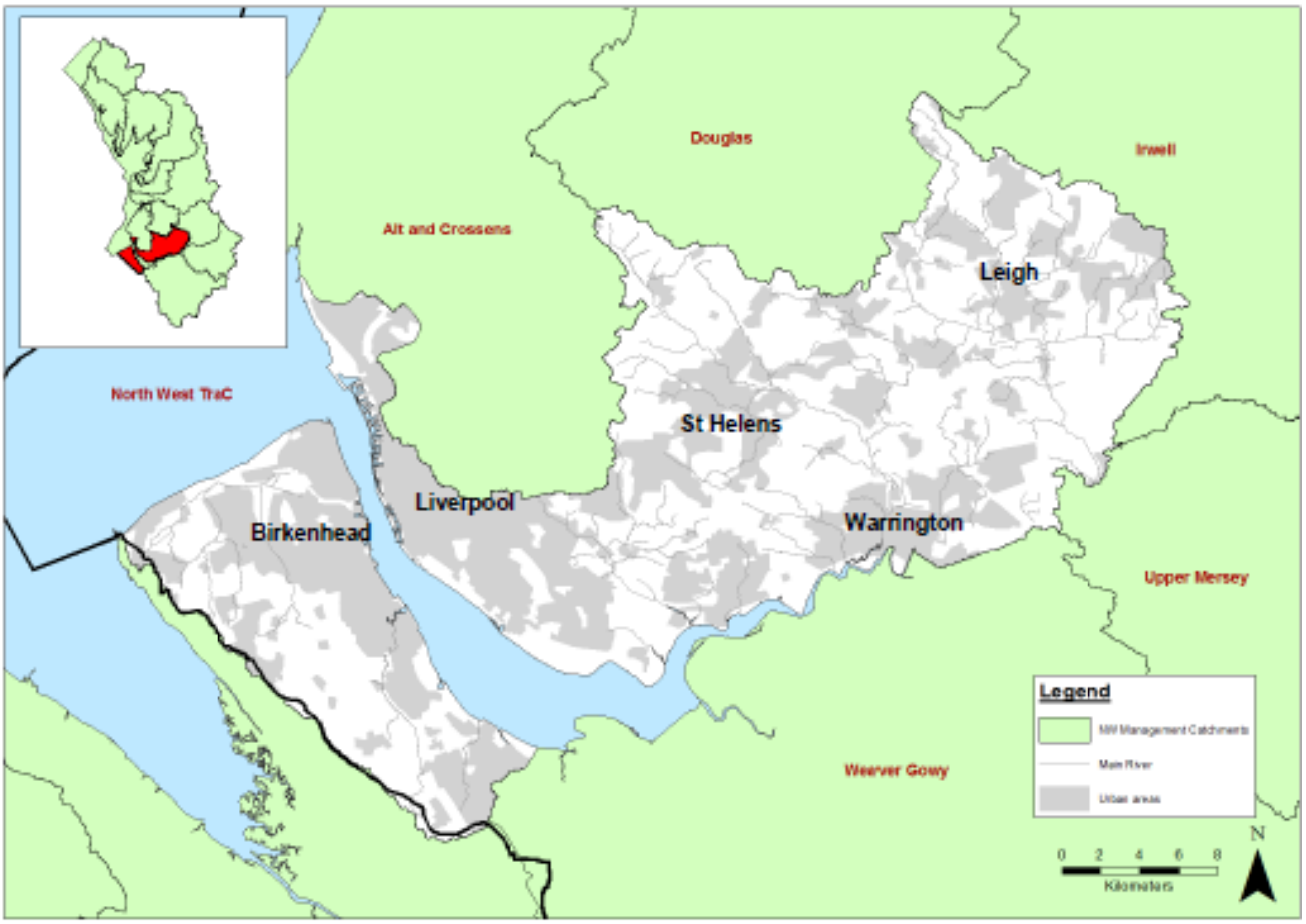
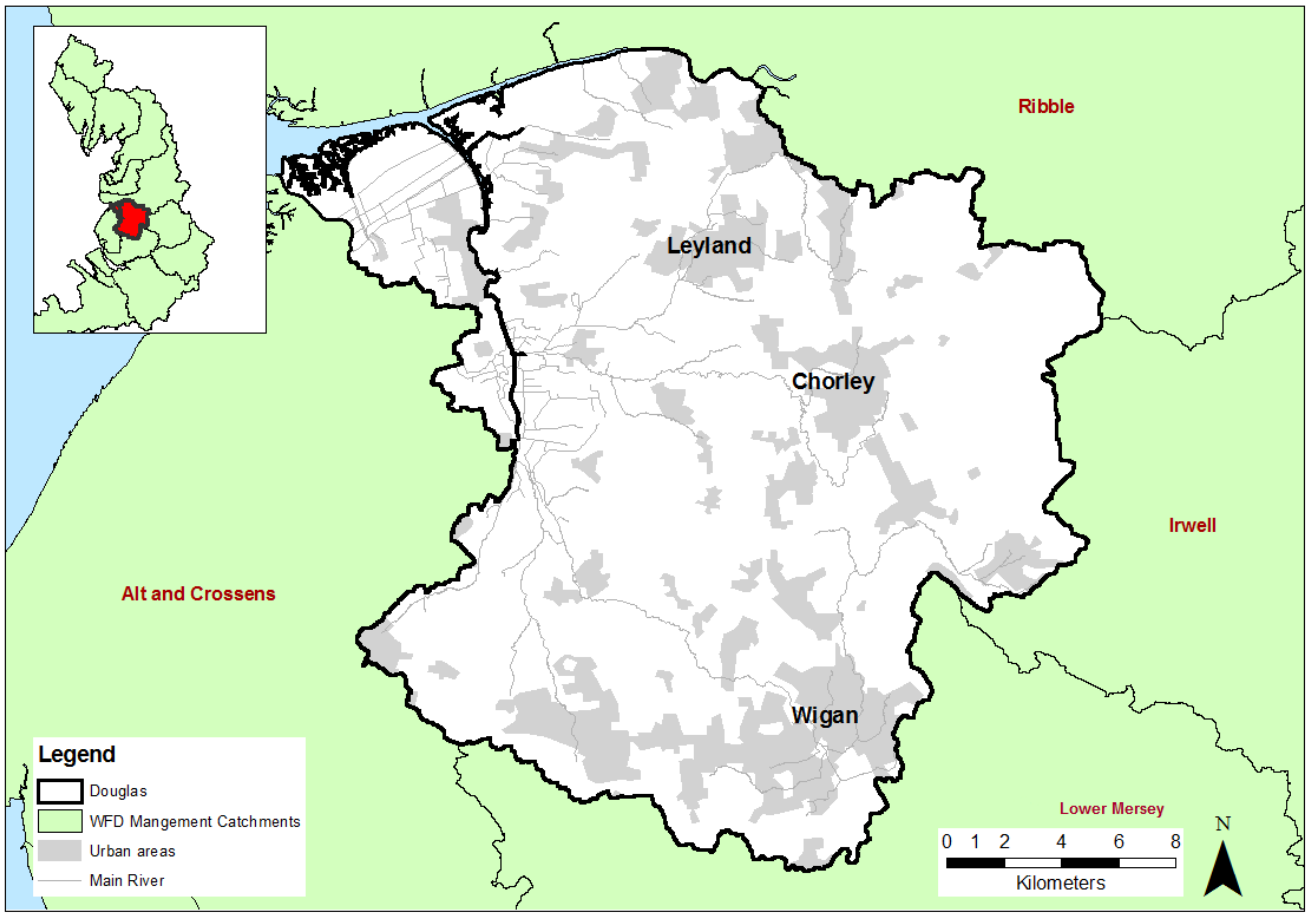


Figure 4-6: Douglas catchment (extracted from NW RBD FRMP Part B report)



4.2.5 Flood and Water Management Act (FWMA)

The FWMA was introduced in April 2010. It aims to improve both flood risk management and the way we manage our water resources.

The FWMA has created clearer roles and responsibilities and helped to define a more risk-based approach to managing flooding. This included the creation of a lead role for LAs, as LLFAs, designed to manage local flood risk (from surface water, groundwater, and ordinary watercourses) and to provide a strategic overview role of all flood risk for the EA.

The content and implications of the FWMA provide considerable opportunities for improved and integrated land use planning and flood risk management by LAs and other key partners.

The integration and synergy of strategies and plans at national, regional, and local scales, is increasingly important to protect vulnerable communities and deliver sustainable regeneration and growth.

Table 4-1 provides an overview of the key LLFA responsibilities under the FWMA.

The Act recognises that "maintaining or restoring natural processes" is a way of managing flood risk and therefore permits the designation of natural features that can reduce this risk.

Table 4-1: Key LLFA Duties under the FWMA

FWMA responsibility	Description of duties and powers
Local Strategy for Flood Risk Management	Each LLFA has a duty to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategies should build on information such as national risk assessments and use consistent risk-based approaches across LA areas and catchments. The local strategy should not be secondary to the national strategy; rather it should have distinct objectives to manage local flood risks important to local communities.
Duty to contribute to sustainable development	Each LLFA has a duty to contribute towards the achievement of sustainable development.
Duty to comply with national strategy	Each LLFA has a duty to comply with national flood and coastal risk management strategy principles and objectives in respects of its flood risk management functions.
Investigating Flood Incidents	Each LLFA, on becoming aware of a flood in its area, has (to the extent it considers necessary and appropriate) to investigate and record details of "locally significant" flood events within their area. This duty includes identifying the relevant risk management authorities and their functions and how they intend to exercise those functions in response to a flood. The responding risk management authority must publish the

FWMA responsibility	Description of duties and powers
	results of its investigation and notify any other relevant risk management authorities.
Asset Register	Each LLFA has a duty to maintain a register of structures or features, which it considers having a significant effect on flood risk, including details on ownership and condition as a minimum. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.
Duty to cooperate and Powers to Request Information	Each LLFA must co-operate with other relevant authorities in the exercise of their flood and coastal erosion management functions.
Ordinary Watercourse Consents	Each LLFA has a duty to deal with enquiries and determine watercourse consents where the altering, removing or replacing of certain flood risk management structures or features that affect flow on ordinary watercourses is required. It also has provisions or powers relating to the enforcement of unconsented works.
Works Powers	The Act provides the LLFAs with powers to undertake works to manage flood risk from surface runoff, groundwater and ordinary watercourses, consistent with the local flood risk management strategy for the area.
Designation Powers	The Act provides the LLFAs with powers to designate structures and features that affect flooding or coastal erosion. The powers are intended to overcome the risk of a person damaging or removing a structure or feature that is on private land and which is relied on for flood or coastal erosion risk management. Once a feature is designated, the owner must seek consent to

FWMA responsibility	Description of duties and powers
	alter, remove, or replace it.
Emergency Planning	Each LLFA is required to play a lead role in emergency planning and recovery after a flood event.
Community Involvement	Each LLFA should engage local communities in local flood risk management issues. This could include the training of community volunteers, the development of local flood action groups and the preparation of community flood plans, and general awareness raising around roles and responsibilities plans.
Planning Requirements for SuDS	SuDS are a planning requirement for major planning applications of ten or more residential units or equivalent commercial development schemes with sustainable drainage. The LLFA is now a statutory planning consultee and it will be between the LPA and the LLFA to determine the acceptability of these proposed sustainable drainage schemes subject to exemptions and thresholds. Approval must be given before the developer can commence construction. LPAs should use planning conditions or obligations to make sure that arrangements are in place for ongoing maintenance of any SuDS over the lifetime of the development.
For latest updates to FWMA legislation[8]	

8 Flood & Water Management Act 2010

4.3 Flood and water focused policies and plans

4.3.1 25 Year Environment Plan[9]

This Plan sets out Government action to help the natural world regain and retain good health. It aims to deliver cleaner air and water in our cities and rural landscapes, protect threatened species and provide richer wildlife habitats. It calls for an approach to agriculture, forestry, land use and fishing that puts the environment first.

The Plan also sets out how Government will tackle the effects of climate change, considered to perhaps be the most serious long-term risk to the environment given higher land and sea temperatures, rising sea levels, extreme weather patterns and ocean acidification.

The Plan aims to show that Government will work with nature to protect communities from flooding, slowing rivers and creating and sustaining more wetlands to reduce flood risk and offer valuable habitats.

Focusing on flood risk, Government will look to update the national flood and coastal erosion risk management strategy, looking to strengthen joint delivery across organisations.

In terms of funding, Government will look at current partnership arrangements ahead of a review of funding needs beyond 2021. This will seek to attract more non-public sector investment, and make sure all relevant agencies are able to respond quickly and effectively to support communities when flooding does occur.

The Plan states that the EA will use its role in statutory planning consultations to seek to make sure that new developments are flood resilient and do not increase flood risk.

For flood mitigation, Government will focus on using more natural flood management solutions; increasing the uptake of SuDS, especially in new development; and improving the resilience of properties at risk of flooding and the time it takes them to recover should flooding occur.

9 25 Year Environment Plan

Figure 4-7: Main goals and policy areas the Plan is intended to help work towards

4.3.2 Water Framework Directive & Water Environment Regulations

The Water Framework Directive (WFD was transposed into English Law by the Water Environment Regulations (2003). Its purpose is to deliver improvements across Europe in the management of water quality and water resources through the RBMPs.

The EA is responsible for monitoring and reporting on the objectives of the WFD on behalf of Government. The second management cycle of the WFD[10] has begun and the second RBMPs were completed in 2015, building upon the first set completed in 2009.

RBMPs are designed to address the pressures facing the water environment in the RBMP districts and identify the actions to address them. The plans set out required objectives and measures to protect and improve the water environment over the next 20 years and aim to achieve WFD targets from 2015 to 2021.

GM is included within the North West RBMP[11].

10 Water Framework Directive timetable

11 North West River Basin Management Plan

Figure 4-8 shows the WFD second cycle Main River classifications. The majority of Main Rivers in GM are classed as having Moderate status.

Moderate status is defined as: *Moderate change from natural conditions as a result of human activity. No restriction on the beneficial uses of the waterbody. No impact on amenity. Some impact on wildlife and fisheries.*

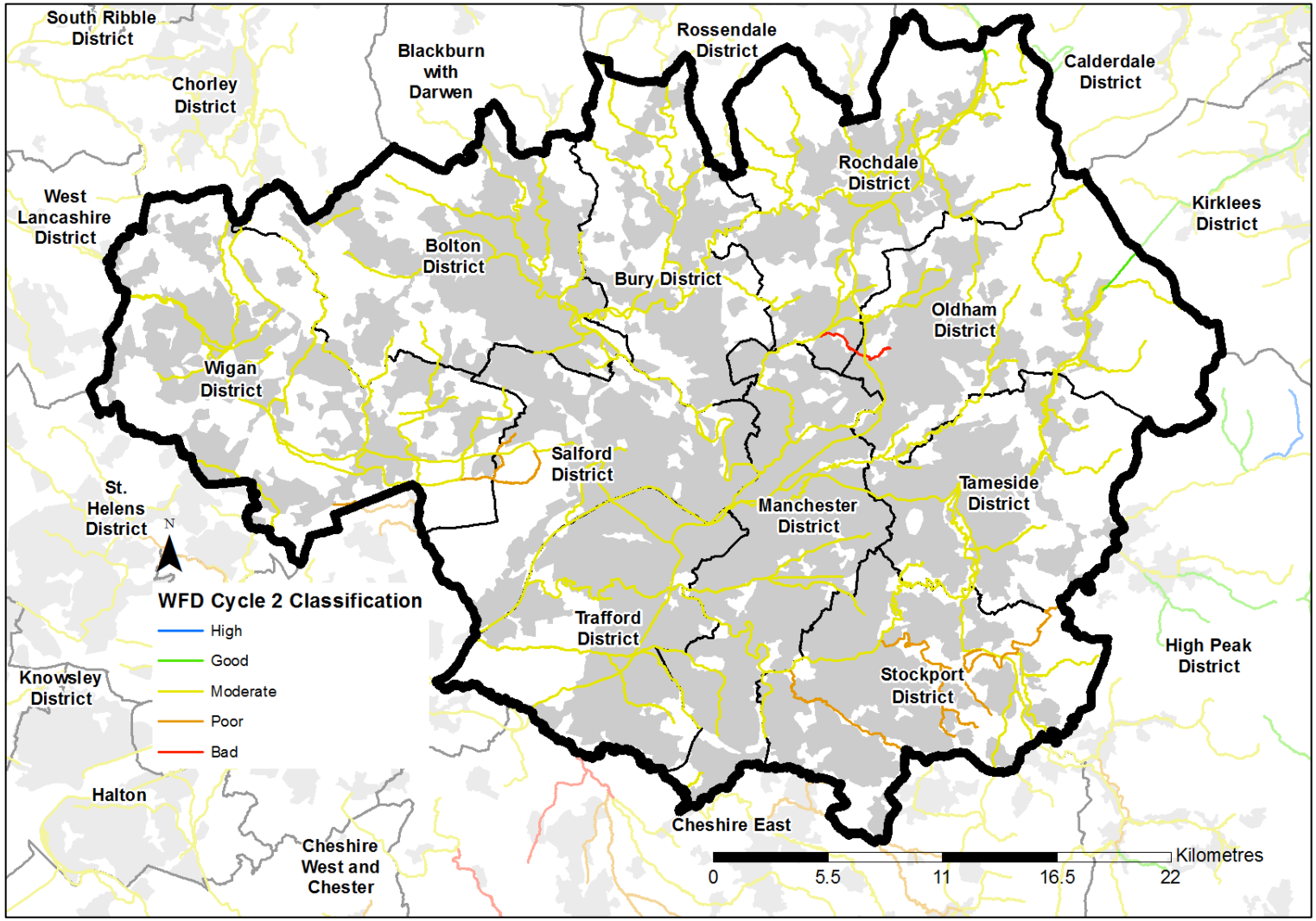
Wince Brook, flowing from Oldham into the River Irk in Rochdale is the only watercourse with Bad status.

Bad status can be defined as: *Severe change from natural conditions as a result of human activity. Significant restriction on the beneficial uses of the waterbody. Major impact on amenity. Major impact on wildlife and fisheries with many species not present.*

A number of Main Rivers in Stockport are classed as having Poor status. This includes the rivers Etherow and Goyt; Torkington Brook; Poise Brook; and Micker Brook. Also, Shaw Brook, Stirrup Brook, Whitehead Brook and Moss House Farm Brook, flowing from Salford into Wigan are of Poor status.

Poor status is defined as: *Major change from natural conditions as a result of human activity. Some restrictions on the beneficial uses of the waterbody. Some impact on amenity. Moderate impact on wildlife and fisheries with many species not present.*

Figure 4-8: WFD Cycle 2 waterbody classification (2016)



The EA has stated that just over 90% of waterbodies in GM are failing their objectives under WFD. The North West RBMP Part 1 document[12] states that the priorities for the Irwell catchment are to address diffuse urban pollution, physical modification, and contamination from sewage treatment.

The Irwell catchment partnership's three key objectives are: cleaner water, more naturally functioning and resilient waterbodies that are better connected, and managed habitats. In terms of flood risk, the partnership has mapped areas in the catchment where green infrastructure can be used to help address surface water flooding.

The RBMPs, like the CFMPs, are important for the development of the SFRA. The SFRA should consider the wider catchment flood cell aims and objectives and understand how it can potentially contribute to the achievement of them for example, with regards to Working with Natural Processes (WwNP).

The main responsibility for GMCA is to work with the EA to develop links between river basin management planning and the development of local authority plans, policies, and assessments. In particular, the general programme of actions (measures) within the RBMPs highlight the need for:

- Water Cycle Studies (WCS) to promote water efficiency in new development through regional strategies and local development frameworks;
- SWMP implementation (see Section 4.7.2.1 for the GM SWMP, 2013);
- Consideration of the WFD objectives (achieving good status or potential as appropriate) in the spatial planning process, including Local Development Documents and Sustainable Community Strategies; and
- Promoting the wide scale use of SuDS in new development.

4.4 Other related plans and policies

4.4.1 EU Funded (Life Integrated) Natural Course Project

Natural Course is an EU LIFE Integrated Project aimed at integrated water management through accelerating delivery towards the objectives of the EU WFD

12 North West River Basin Management Plan Part 1

and improved flood risk management. The project spans the North West England River Basin District, with an early focus on the River Irwell catchment.

Natural Course is delivered by a partnership comprising the EA, UU, the GMCA (with Salford City Council acting as lead authority), the Rivers Trust and Natural England.

Because of the scale, complexity and in some cases the high cost of WFD delivery, Natural Course focuses on integration; both between the project partners and more widely among organisations and sectors that can contribute to integrated water management.

Natural Course promotes an integrated catchment approach, working through the established network of Catchment Partnerships and employs a Natural Capital approach to tackling the challenges presented by the WFD and increased flood risk management where possible.

Natural Course began in October 2015 and will run for 10 years with budgets and work programmes split into four equal phases of 2.5 years.

The first phase of Natural Course is the development of an integrated water management framework through a series of “Preparatory Actions” including:

- A desk top collection and analysis of existing data, or evidence, from the River Irwell catchment and development of a programme of works, or measures to address the challenges presented by the WFD (Irwell Evidence and Measures Report, APEM Ltd 2017).
- Collation and sharing of ecological and environmental information about the River Irwell catchment working with volunteers to conduct surveys aimed at filling gaps in knowledge about the ecology of the catchment.
- Modelling the River Irwell catchment to understand the potential value and impact of Natural Flood Risk Management (NFRM) interventions to contribute to reduced flood risk across the catchment (Irwell Natural Flood Management Mapping, JBA Consulting / Rivers Trust 2017).
- Understanding and mapping the opportunities to restore and re-naturalise “heavily-modified” waterbodies so as to provide maximum ecosystem service benefits across the River Irwell catchment (A Natural Capital

Account and Ecosystem Services Opportunities Mapping for the Irwell Management Catchment, TEP / Vivid Economics - finalised April 2018).

- Identifying and understanding the synergies between water management challenges and sources of investment from different sectors and opportunities to align investment to enhance and accelerate delivery of multiple water management benefits for the River Irwell catchment.

The development of the GMSF provides an opportunity to set an integrated water management approach in the wider economic, social, growth and infrastructure plans for the conurbation.

4.4.2 Catchment partnerships

The Catchment Based Approach[13] (CaBA) embeds collaborative working at a river catchment scale to deliver cross cutting improvements to our water environments. The CaBA partnerships drive cost-effective practical delivery on the ground, resulting in multiple benefits including reduced flood risk and resilience to climate change.

Catchment partnerships are groups of organisations with an interest in improving the environment in the local area and are led by a catchment host organisation. The partnerships work on a wide range of issues, including the water environment but also address other concerns that are not directly related to river basin management planning.

Government is also working to strengthen or establish partnerships in the areas most affected by the December 2015 floods to encourage a more integrated approach to managing risk across all catchments.

The National Resilience Review aligns closely with Defra's work on integrated catchment-level management of the water cycle in Government's 25 year Environment Plan (see Section 4.3).

Government's aspirations for the next cycle of planning (now to 2021) is for more integrated catchment planning for water, where Flood and Coastal Risk

13 Catchment Based Approach

Management, River Basin Management, nature conservation and land management are considered together.

Catchment partnerships relevant to GM:

- Rivers Return - the Irwell Catchment Partnership; hosted by Groundwork Manchester, Salford, Tameside, and Trafford.

  A strategic plan has been developed, identifying key issues, and an action plan is under development. The partnership is helping to identify the location and details for priority projects, seeking funding and consulting and engaging with local people to encourage their involvement in identified projects.

  At the time of writing, such projects include:

  - River stewardship; commissioned by the EA. This work led to successful application of Defra's Payment for Ecosystem Services (PES[14]) pilot expanding work with businesses in the market research and development project.
  - Little and often Maintenance of the riparian corridor; commissioned by the EA. It was found that the third sector and social enterprises could provide maintenance and improvements to assets at a high quality and lower cost and could also provide greater social benefits than through other teams.
- Upper Mersey Catchment Partnership; hosted by Mersey Rivers Trust.

  At the time of writing, this partnership is forming a vision for the catchment and the steering group is developing a catchment plan.

  Key projects include:

  - Mersey Starts Well (aim to improve the ecological health and amenity value of the Mersey at its source by focusing on the Tame, improving the potential for it to be 'opened up' in the future),
  - Returning Rivers,
  - Slow the Flow,

14 Payments for ecosystem services

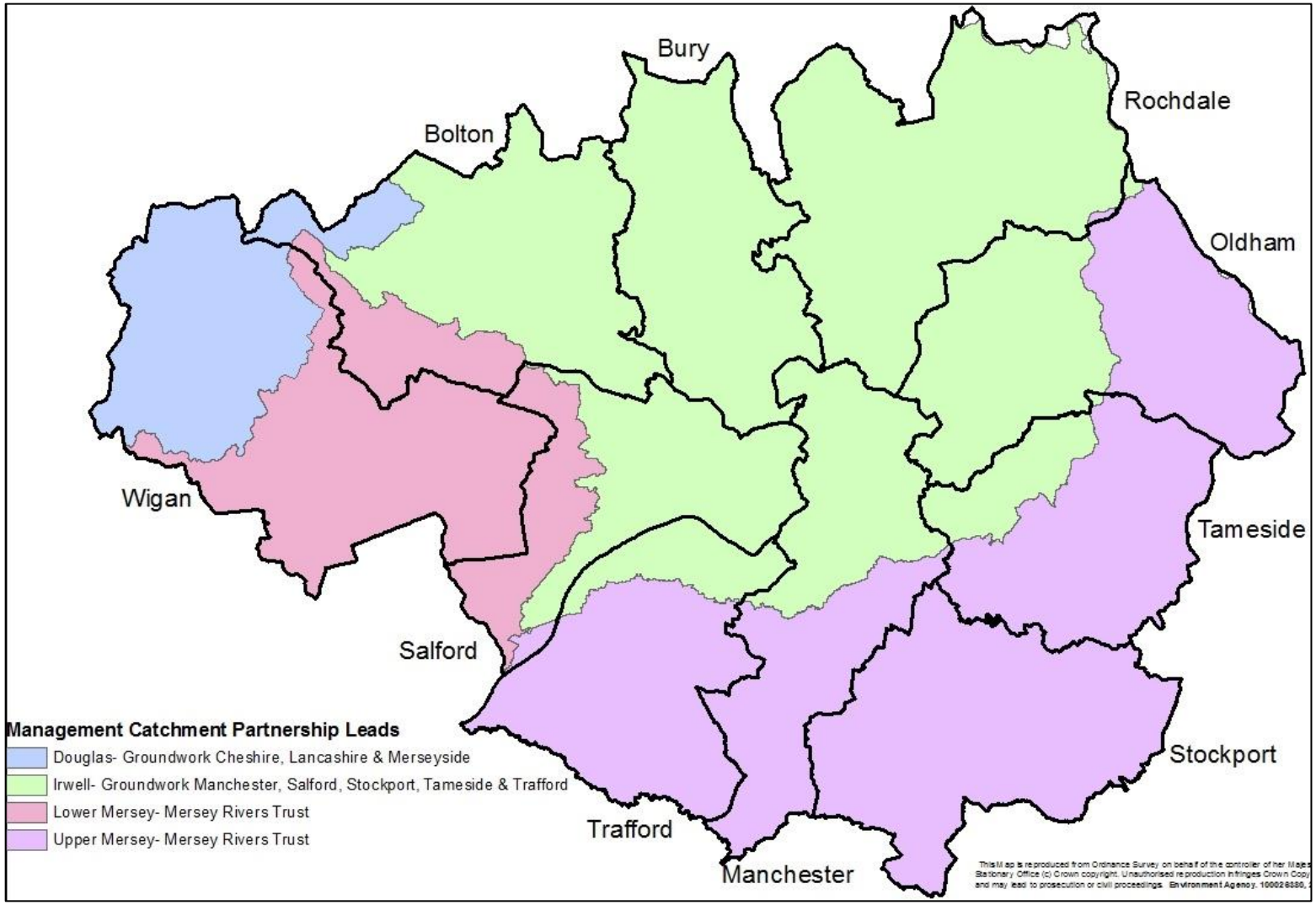
- Gravel Management Plan,
- Community SCAMP,
- Cheshire Meres and Brooks,
- Misconnection Hotspots,
- Making the most of Construction Opportunities,
- Etherow Bundle and
- Bollin Bundle.

- Lower Mersey Catchment Partnership; hosted by Mersey Rivers Trust.

  At the time of writing, this partnership is forming a vision for the catchment and the steering group is developing a catchment plan.
- Douglas Catchment Partnership; hosted by Groundwork Lancashire, West and Wigan.

Figure 4-9 shows the spatial nature of the catchment partnerships within GM.

Figure 4-9: Management Catchment Partnership Leads



4.5 Planning legislation

4.5.1 Housing and Planning Act, 2016

This Act provides the statutory framework to build more homes that people can afford, expand home ownership, and improve housing management. The Act places a duty on local authorities to promote the development of starter homes, custom and self-build homes.

The Act simplifies and speeds up the neighbourhood planning process to support communities that seek to meet local housing and other development needs through neighbourhood planning.

In addition, the Act seeks to ensure that every area has a Local Plan whilst also giving the Secretary of State further powers to intervene if Local Plans are not effectively delivered.

4.5.2 Localism Act 2011

The Localism Act was given Royal Assent in November 2011 with the purpose of shifting power from Central Government back to local councils, communities, and individuals.

Government abolished Regional Spatial Strategies, aiming to provide the opportunity for councils to re-examine the local evidence base and establish their own local development requirements for employment, housing and other land uses through the plan making process.

Additionally, this act places a duty to cooperate on local authorities, including statutory bodies and other groups, in relation to the planning of sustainable development.

This duty to cooperate requires local authorities to:

"...engage constructively, actively and on an ongoing basis in any process by means of which development plan documents are prepared so far as relating to a strategic matter." (Provision 110).

This act, together with the Neighbourhood Planning (General) Regulations 2012, also provides new rights to allow Parish or Town Councils to deliver additional development through neighbourhood planning (Neighbourhood Plans).

This means local people can help decide where new homes and businesses should go and what they should look like.

LPAs can provide technical advice and support as neighbourhoods draw up their proposals. Neighbourhood Plans have several conditions and requirements as set out in the NPPF.

Paragraphs 061-064 of the FRCC-PPG provide information on neighbourhood planning and flood risk. In terms of flood risk, neighbourhood planning qualifying bodies should (Paragraph 061):

- *Seek to ensure neighbourhood plans and neighbourhood development / community right to build orders are informed by an appropriate assessment of flood risk;*
- *Ensure policies steer development to areas of lower flood risk as far as possible;*
- *Ensure that any development in an area at risk of flooding would be safe, for its lifetime taking account of climate change impacts;*
- *Be able to demonstrate how flood risk to and from the plan area / development site(s) will be managed, so that flood risk will not be increased overall, and that opportunities to reduce flood risk, for example, through the use of SuDS, are included in the plan / order.*

4.6 Planning policy

4.6.1 National Planning Policy Framework (NPPF), 2019

The revised NPPF was published in July 2018, replacing the previous version published in March 2012. This was further updated in February 2019. The NPPF sets out Government's planning policies for England and how these are expected to be applied.

The Framework is based on core principles of sustainability and forms the national policy framework in England, also accompanied by several Planning Practice Guidance (PPG) notes. It must be considered in the preparation of local plans and is a material consideration in planning decisions.

The PPG documents will, where necessary, be updated in due course to reflect the changes in the revised NPPF.

Section 14 Paragraph 156 of the 2019 NPPF states that…

"...Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They 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."

- The Sequential Test must be performed when considering the placement of future development and for planning application proposals.
- The Sequential Test is used to direct all new development (through the site allocation process) to locations at the lowest probability of flooding.
- Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding.
- The strategic flood risk assessment will provide the basis for applying this test.
- The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

The key changes in the revised 2019 NPPF include:

- Strategic policies should also now consider the 'cumulative impacts in, or affecting, local areas susceptible to flooding' (para 156), rather than just to or from individual development sites (see Section 7.8);
- Future risk from climate change. The 'sequential approach should be used in areas known to be at risk now or in the future from any form of flooding' (para 158) (see Sections 6.9.1, 7.2.2, 7.3.3 and Appendix B);
- Natural Flood Management. 'Using opportunities provided by new development to reduce the causes and impacts of flooding (where

appropriate through the use of natural flood management techniques)' (para 157c) (see Sections 6.8.5, 7.3.4 and Appendix B);

- SuDS. 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165) (see Section 7.11.1 and Appendix F); and
- Emergency planning. Emergency plans are required as part of an FRA that includes the inclusion of safe access and egress routes (para 163e) (Section 8).

As explained, the FRCC-PPG sits alongside the NPPF and sets out detailed guidance on how this policy should be implemented.

4.6.2 Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG),

At the time of writing, the current FRCC-PPG was published on 6 March 2014 and is available online via:

Flood Risk and Coastal Change Planning Practice Guidance

Following the revision of the NPPF, Government will, where necessary be updating the FRCC-PPG to reflect the changes discussed above in Section 4.6.1. It is advised that any hyperlinks within the FRCC-PPG that direct users to the previous 2012 NPPF should be disregarded.

Whilst the NPPF concentrates on high level national policy, the FRCC-PPG is more detailed. The practice guidance advises on how planning can take account of the risks associated with flooding and coastal change in plan making and the development management process. This is in respect of:

- local plans,
- SFRAs,
- the sequential and exception tests,
- permitted development,
- site-specific flood risk,
- Neighbourhood Planning,
- flood resilience and resistance techniques and

- the vulnerability of development to make development safe from flooding.

As discussed, the FRCC-PPG may in the future be updated in places to reflect the revised NPPF.

4.7 Flood Risk Management policy

4.7.1 National and Local Flood Risk Management Strategies

As presented in Figure 4-1, the FWMA establishes how flood risk will be managed within the framework of the National Strategy for England and local strategies for each LLFA area.

The National Strategy for England has been developed by the EA with the support and guidance of Defra. It sets out principles for how flood risk should be managed and provides strategic information about different types of flood risk and which organisations are responsible for their effective management.

The FWMA requires risk management authorities (local authorities, EA, sewerage companies and highways authorities) to work together and act consistently with the National Strategy in carrying out their flood and coastal erosion risk management functions.

These functions should be carried out effectively, efficiently and in collaboration with communities, businesses, and infrastructure operators to deliver more effective flood risk management. This was published in 2011 and is, at the time of writing, being reviewed with the intention for a new Strategy to be issued in 2019.

LLFAs are responsible for developing a LFRMS for their area covering local sources of flooding, as stated in Table 4-1. The local strategy produced must be consistent with the National Strategy.

The local strategy should set out the framework for local flood risk management functions and activities and should raise awareness of local organisations with responsibilities for flood risk management in the area.

The strategy should also facilitate partnership arrangements to ensure co-ordination between local organisations and an assessment of flood risk and plans and actions for managing risk, as set out under Section 9 of the FWMA.

The following link provides links to guidance for RMAs and local authorities on various subjects of flood risk management, including tools to support LLFAs in developing their LFRMS:

Flood risk management: information for flood risk management authorities, asset owners and local authorities

Each of the ten GM authorities has produced a LFRMS; measures and objectives from which have been considered in the development of the GM SFRMF.

4.7.2 Surface Water Management Plans

In June 2007, widespread extreme flooding was experienced in the UK. Government review of the 2007 flooding, chaired by Sir Michael Pitt recommended that…

"…Local Surface Water Management Plans (SWMPs) … coordinated by local authorities, should provide the basis for managing all local flood risk."

Government's SWMP Technical Guidance document[15], 2011, defines a SWMP as:

- *A framework through which key local partners with responsibility for surface water and drainage in their area, work together to understand the causes of surface water flooding and agree the most cost-effective way of managing surface water flood risk.*
- *A tool to facilitate sustainable surface water management decisions that are evidence based, risk based, future proofed and inclusive of stakeholder views and preferences.*
- *A plan for the management of urban water quality through the removal of surface water from combined systems and the promotion of SuDS.*

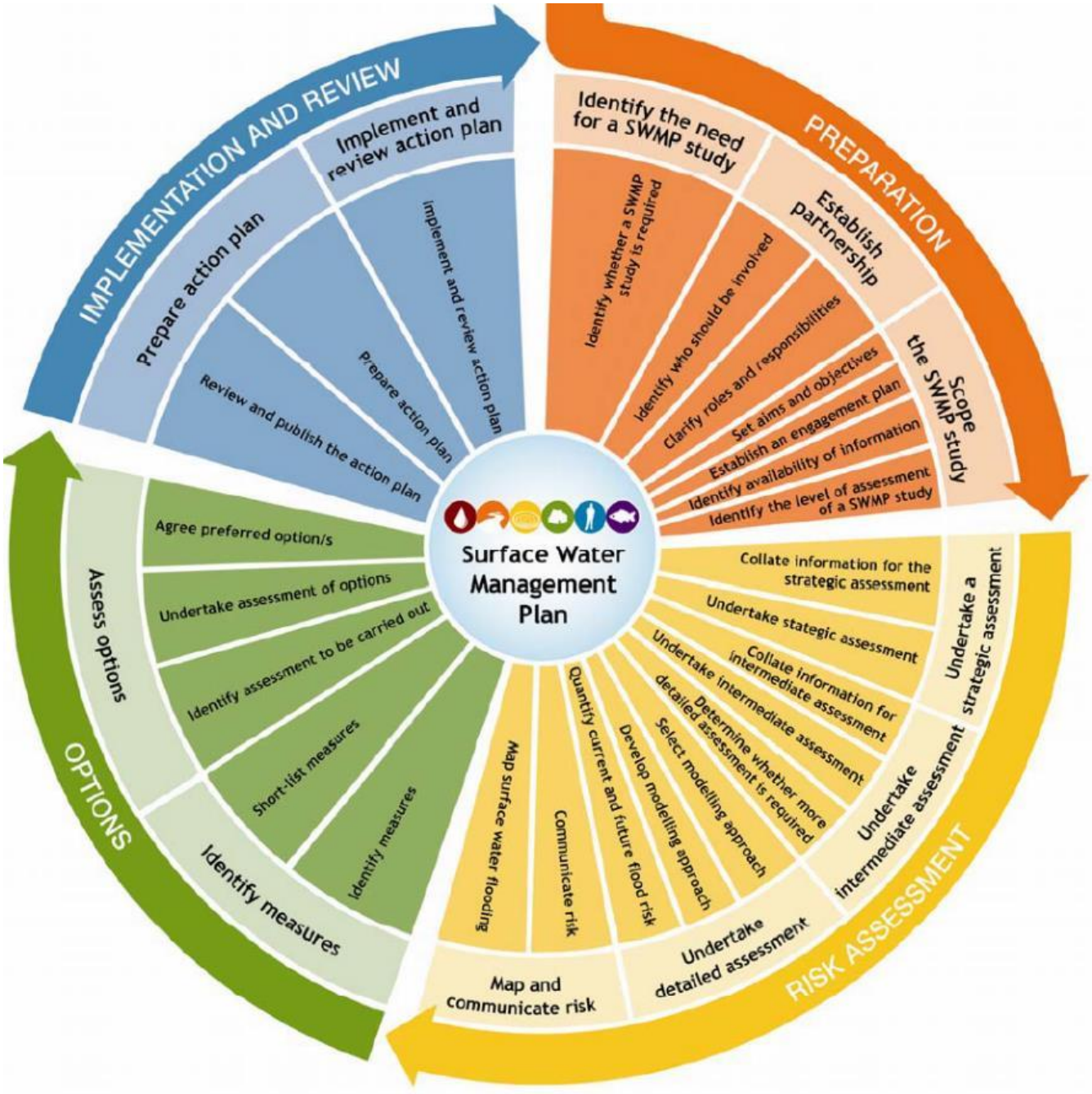
As a demonstration of its commitment to SWMPs as a structured way forward in managing local flood risk, Defra announced an initiative to provide funding for the highest flood risk authorities to produce SWMPs.

15 Surface Water Management Plan Technical Guidance

Defra's framework for carrying out a SWMP is illustrated by the SWMP wheel diagram, as shown in Figure 4-10.

The first three phases involve undertaking the SWMP study, whilst the fourth phase involves producing and implementing an action plan which is devised based on the evidence gained from the first three phases.

Figure 4-10: Defra wheel (taken from SWMP Technical Guidance)



4.7.2.1 Greater Manchester Surface Water Management Plan, 2013

The GM SWMP was completed in February 2013 and included all four phases of the Defra wheel.

Stage 1 of the GM SWMP related to the first two phases of the Defra wheel, from which, partnerships were formed and a strategic assessment of surface water flood risk across GM was carried out.

This strategic assessment of risk used sub-regional surface water modelling to produce hazard outputs, which were then overlaid with the location of local critical and vulnerable receptors to identify potential areas of significant surface water flood risk, known as surface water 'Hotspots'.

A total of 580 Hotspot locations were identified. These locations are shown on Figure 6-8 for historic surface water flooding indications. For those areas within the Hotspots a more detailed understanding of surface water flood risk was required, and an action plan was put in place to address this.

The fourth phase, the preparation of the Action Plan for GM, translates the recommendations made during the first three phases into a series of distinct and measurable actions. These are designed to facilitate further investigation and management of surface water flood risk across GM in the future. These actions are listed in Table 4-2 which is a direct extract from the GM SWMP report[16].

The Action Plan was designed to be a living document that would continue to grow and evolve as additional stages of the SWMP process were completed, and further investigations and works were carried out either across GM as a whole or at individual locations through each LLFA's LFRMS.

The idea was that Local Strategies would integrate these actions into the frameworks for which each authority would manage future flood risk.

16 Greater Manchester Surface Water Management Plan, Overarching Report, February 2013

Table 4-2: GM SWMP generic actions

Recommended Action	Reason for Action	Lead organisation and Likely Partner Organisations
Carry out surveys to inform and complete sewer maps together with providing understanding on location and condition of assets	Filling gaps in the sewer networks across areas provides confidence in sewer capacity and flow routes. Provides information on asset locations	UU (United Utilities) with LLFA
Update asset plans and registers with collected data from this study	Update names and routes of culverted watercourses and proved connectivity on asset plans	UU and LLFA
Carry out regular maintenance of features conveying surface water	The sewer networks have been designed specifically for carrying water and if the network is partially blocked then the available capacity isn't being used effectively or efficiently	UU
Carry out regular maintenance of features collecting surface water	Highway gulley maintenance is important to allow surface water to enter the sewer network	LLFA
Improving the maintenance regime of watercourses may have both environmental and ecological benefits to the watercourse and public open spaces	There could be links to WFD and alternative funding sources for this work	LLFA with EA
Carry out design reviews of sewer network capacity	Understanding where there are 'pinch points' in networks can allow focus for both	UU with EA, LLFA and Local Businesses

Recommended Action	Reason for Action	Lead organisation and Likely Partner Organisations
	maintenance and future planned refurbishment or replacement schemes	
Gaining a better understanding land ownership	Knowing the locations where water can be stored or safely conveyed overland can relieve pressure on existing overwhelmed sewer networks	LLFA with EA, UU Local Businesses
Better recording of flood incidents	Keeping flood locations, dates, maps of flooded areas, photographs and suggested reasons for flooding help future analysis understand mechanisms and provide justification for future schemes	LLFA with EA and UU Approach Emergency services for their records
Increase technical capacity of LLFAs responsible for managing local flood risk	Capacity building, recruitment, education and training.	LLFAs possible secondment opportunities from EA
Use Planning to promote SuDS in appropriate new developments and as integral part of highway resurfacing and refurbishment	Reduce surface water runoff and increase storage at source. Reduce the amount of surface water ending up in the sewer network during high flows.	LLFAs

4.7.3 Critical Drainage Areas (CDA)

CDAs can be designated by LPAs or LLFAs for their own purposes with several having been drafted as part of previous SFRAs carried out by the GM authorities. Each GM council has developed policy to attach to the CDAs.

Such policy can include:

- minimum requirements for runoff volumes from development sites;
- a preference for a certain type of SuDS;
- drainage strategies to be in place for larger development sites;
- stricter requirements on site-specific FRAs i.e. lowering the requirement for FRAs to sites greater than half a hectare in size rather than one hectare.

Table 4-3 states the policy each authority is using.

Table 4-3: CDA policy for each GM authority

Authority	CDA Policy Brownfield sites	Greenfield sites	Other
Bolton	50% less than pre-development	No worse than existing	Policy applies on a borough-wide scale and not just to development within a CDA
Bury	50% less than pre-development	Current runoff up to 1 in 100 AEP event + climate change	Development should be designed so that there is no flooding to the development in a 1 in 30 AEP event and no property flooding in a 1 in 100 year plus climate change event
Manchester	50% less than pre-development	Current runoff up to 1 in 100 AEP event + climate change	FRAs required for all development over 0.5 ha in CDAs and to have regard to recommended runoff rates; development should be designed so that there is no flooding to the development in a 1 in 30 AEP event and no property

Authority	CDA Policy Brownfield sites	Greenfield sites	Other
			flooding in a 1 in 100 year plus climate change event
Oldham	50% less than pre-development	Current runoff up to 1 in 100 AEP event + climate change	FRAs required for all development over 0.5 ha in CDAs and to have regard to recommended runoff rates; development should be designed so that there is no flooding to the development in a 1 in 30 AEP event and no property flooding in a 1 in 100 year plus climate change event
Rochdale	50% less than pre-development	Current runoff up to 1 in 100 AEP event + climate change	Any site within a CDA requires regard to SFRA and full compliance with any strategy for CDA areas
Salford	50% less than pre-development	Current runoff up to 1 in 100 AEP event + climate change	FRAs required for all development over 0.5 ha in CDAs and to have regard to recommended runoff rates; development should be designed so that there is no flooding to the development in a 1 in 30 AEP event and no property flooding in a 1 in 100 year plus climate change event
Stockport	50% less than pre-development	Unknown	FRAs for sites over 0.5 ha
Tameside	50% less than pre-	Unknown	Policy applies on a borough-wide scale and not just to development

Authority	CDA Policy Brownfield sites	Greenfield sites	Other
	development		within a CDA
Trafford	50% less than pre-development	Current runoff up to 1 in 100 AEP event + climate change	FRAs required for all development over 0.5 ha in CDAs and to have regard to recommended runoff rates; development should be designed so that there is no flooding to the development in a 1 in 30 AEP event and no property flooding in a 1 in 100 year plus climate change event
Wigan	50% less than pre-development	Current runoff up to 1 in 100 AEP event + climate change	FRAs required for all development over 0.5 ha in CDAs and to have regard to recommended runoff rates; development should be designed so that there is no flooding to the development in a 1 in 30 AEP event and no property flooding in a 1 in 100 year plus climate change event

As stated in the Project Brief, the CDA boundaries were to be reviewed as part of this SFRA. A high-level review has therefore been carried out.

However, given data restrictions, the decision has been taken by GMCA that the existing CDAs should remain alongside new 'Opportunity Areas for Further Critical Drainage Management' (OAFCDM), drafted based on historic surface water flood incidents.

The policy stated in Table 4-3 should still apply to proposed developments within a CDA, though the OAFCDMs should also be considered alongside the CDAs, by the applicable LLFA and LPA, for further critical drainage management.

Section 6.4.3 provides information on how the OAFCDMs have been delineated.

It is recommended that both the CDAs and OAFCDMs are reviewed and refined using more detailed information as part of any future investigation / study i.e. Level 2 SFRA, surface water flood risk assessment.

4.7.4 UU Water Resources Management Plan (2015-2040)

There is very little reference to flooding other than issues in Cumbria (Thirlmere reservoir). The issue of flooding is not directly related to the Water Resources Management Plan process. It is primarily concerned with maintaining adequate water supplies to customers over the coming 25 years.

The EA is responsible for flooding (e.g. river and coastal) and have a programme of measures in place to protect communities from flooding. To minimise the impact of flooding it is possible to construct purpose-built flood storage basins or to implement controlled flooding measures (e.g. where lowlands are permitted to flood).

UU water supply reservoirs are built for the purpose of water supply however they do provide some flood attenuation. However, this is often a minimal impact due to the comparative volume of water arriving in a flood and the available storage in a reservoir.

4.7.5 Greater Manchester Green Infrastructure

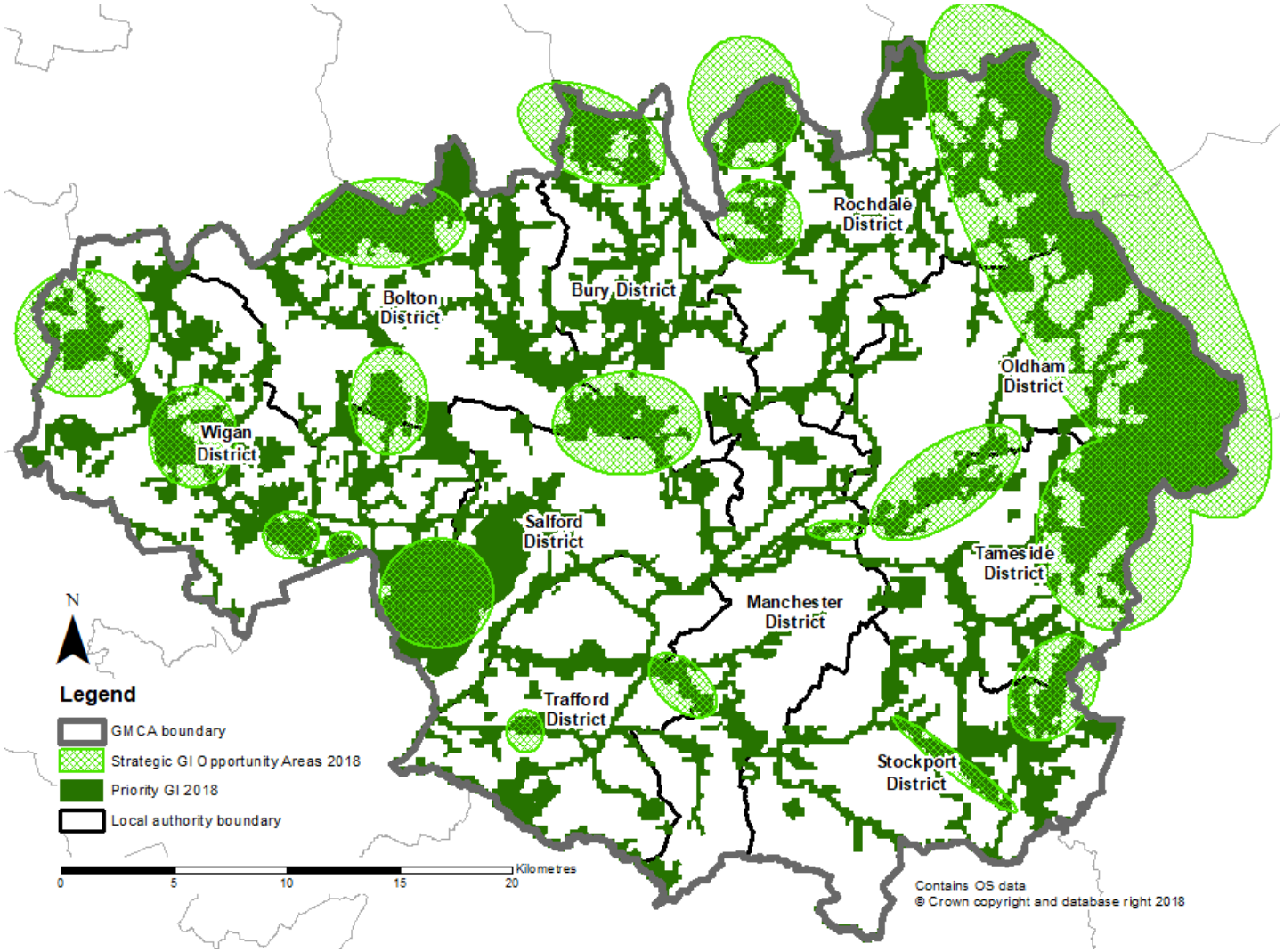
The most up-to-date and available report regarding priority green and blue strategic infrastructure is the Updated Priority Green Infrastructure Study produced in May 2018.

This report describes the approach to identifying and mapping the Priority Green Infrastructure (GI) of GM. These areas of Priority GI, and also several broad strategic GI opportunity areas, are shown in Figure 4-11 and included on the SFRA Maps in Appendix A.

The mapped Priority GI areas represent existing GI assets and not those that provide opportunities for the development of GI and NFM. The focus was on identifying Strategic Priority GI for GM. However, it does not ignore the fact that small areas of GI can have value at a more local level and does not imply that

more local GI is unimportant; all areas of GI should be considered on merit when considering development.

Figure 4-11: Priority GI network and strategic GI opportunity areas



The document suggests GI policies for the GMSF:

- Policy for Nature Conservation (existing designated sites)
- Policy for the Protection of the Strategic Green and Blue Infrastructure Network
- Policy for the Protection of Nature Improvement Areas
- Policy for Protection of Blue Infrastructure
- Policy for the Conservation of Species Protected by Law
- Policy for the Protection of Green Belt.

4.8 Roles and responsibilities in planning and flood risk management

RMA responsibilities under the FWMA and the FRR, as summarised by Government[17], include the following:

4.8.1 EA as a RMA

- Has a strategic overview role for all forms of flooding;
- Provides and operates flood warning systems;
- Carries out works to manage flood risk from the sea and main rivers;
- Carries out works in estuaries to secure adequate outfalls for main rivers;
- Carries out surveys to inform FCERM works and has the right to enter private land to carry out such works;
- Issues consent for works on or near main rivers, and works affecting watercourses, flood and sea defences and other structures protected by its byelaws;
- Designates structures and features of the environment that affect flood or coastal erosion risk
- Has the power to request information from any partner in connection with its risk management functions;
- Must exercise its flood or coastal erosion risk management functions in a manner consistent with the National Strategy and local strategies;

17 Flood and coastal erosion risk management authorities

- Must be consulted on local strategies, if affected by the strategy, by the LLFA; and
- Must help advise on sustainable development.

4.8.2 LPA as a RMA

- Has a duty to act in a manner that is consistent with the National Strategy and have regard to local strategies;
- Must be consulted on local strategies, if affected by the strategy, by the LLFA;
- Has a duty to be subject to scrutiny from the LLFA; and
- Has a duty to cooperate and share information with other RMAs.

4.8.3 LLFA as a RMA

- Must develop, maintain, apply and monitor a strategy for local flood risk management. This must be consulted on with all RMAs, the public and all other partners with an interest in local flood risk, and must comply with the National Strategy;
- Should prepare and maintain a preliminary flood risk assessment, flood hazard maps, flood risk maps and flood risk management plans;
- Is required to coordinate and share information on local flood risk management between relevant authorities and partners;
- Is empowered to request information from others when it is needed in relation to its flood risk management functions;
- Must investigate significant flooding incidents in its area where it considers it necessary or appropriate;
- Has a duty to establish and maintain a record of structures within its area that it considers to have a significant impact on local flood risk;
- Is empowered to designate structures and features that affect flooding;
- Has powers to undertake works to manage flood risk from surface runoff, groundwater and ordinary watercourses;
- Can grant consents for culverts, dams and weirs on ordinary watercourses;

- Must exercise its flood and coastal erosion risk management functions in a manner consistent with the National Strategy and the applicable Local Strategy;
- Can carry out work that may cause flooding or coastal erosion in the interests of nature conservation, preservation of cultural heritage or people's enjoyment of the environment or cultural heritage;
- Can acquire land in or outside of their district for use in flood risk management if necessary;
- Is permitted to agree the transfer of responsibilities for risk management functions (except the production of a local strategy) to other RMAs;
- Can take the lead on preparing SWMPs;
- Must aim to contribute to sustainable development; and
- Should consider flooding issues that require collaboration with neighbouring LLFAs and other RMAs.

4.8.4 UU as a RMA

- Has a duty to act in a manner that is consistent with the National Strategy and have regard to local strategies when:
- Must be consulted on Local Strategies, if affected by the strategy, by the relevant LLFA;
- Has a duty to be subject to scrutiny from LLFAs;
- Has a duty to cooperate and share information with other RMAs; and
- Is responsible for managing the risks of flooding from surface water and foul or combined sewer systems providing drainage from buildings and yards.

4.8.5 Highways Authority and Highways England as RMAs

- Has a duty to act in a manner that is consistent with the National Strategy and have regard to local strategies when:
    - carrying out highway drainage works,
    - filling in roadside ditches,
    - diverting or carrying out works on part of a watercourse;

- Have responsibility for ensuring effective drainage of local roads in so far as ensuring drains and gullies are maintained;
- Must be consulted on local strategies, if affected by the Strategy, by the LLFA; and
- Have a duty to be subject to scrutiny from LLFAs.

4.8.6 The Local Community

- Must be consulted on local strategies by the LLFA; and
- Has a key role in ensuring local strategies are capable of being successfully delivered within the community. They should actively participate in this process and be engaged by the LLFA.

4.8.7 Riparian owners

A riparian owner is someone who owns land or property alongside a river or other watercourses. A watercourse is any natural or artificial channel through which water flows including flow through a culvert, ditch, drain, cut, dyke, sluice or private sewer.

Riparian owners have statutory responsibilities, including:

- Maintaining watercourses;
- Allowing the flow of water to pass without obstruction; and
- Controlling invasive alien species.

Further guidance for riverside property owners can be found online via:

https://www.gov.uk/guidance/owning-a-watercourse

4.8.8 Developers

Have a vital role in ensuring effective local flood risk management by avoiding development in areas at risk of flooding. The local strategies and the proposed GM Strategic Framework for Flood Risk Management should form key elements of local planning guidance, along with consultation of this SFRA.

5 Greater Manchester Spatial Framework (GMSF)

The SFRMF is intended to support and inform the 2019 GMSF[18] and in turn is informed by the GM SFRA. The GMSF is a joint plan for Greater Manchester that will provide the land for jobs and new homes across the city region, setting out ambitious plans seeking 'to make Greater Manchester one of the best places in the world'.

The Framework is being produced by the 10 local authorities working together in partnership. It is intended to support Greater Manchester's growth ambitions by ensuring that the right time and amount of land is available in the right places to deliver the homes and jobs required by 2037. It will also identify the new infrastructure required to achieve this.

By working in a coordinated way, it is hoped that the GMSF can achieve joined up decision making both locally and at a Greater Manchester level.

The draft GMSF proposes to deliver a minimum of 201,000 homes by 2037. It identifies 14 strategic locations as being significant in terms of their economic importance and role in meeting future development needs. These are:

- **Manchester City Centre -** lies at the heart of Greater Manchester, straddling the boundary between Manchester and Salford
- **Main town centres** - Altrincham, Ashton-Under-Lyne, Bolton, Bury, Oldham, Rochdale, Stockport and Wigan
- **The Quays** - located just to the south-west of the City Centre, in Salford and Trafford, focused around the Manchester Ship Canal and a series of bays and basins
- **Port Salford -** will be the UK's first tri-modal inland waterway port, located on the Manchester Ship Canal
- **M62 North East Corridor** - from M62junction 18 (the confluence with the M60 and M66) to junction 21 (Milnrow), extending across parts of Bury,

18 Greater Manchester's Plan for Homes, Jobs and the Environment. Greater Manchester Spatial Framework Revised Draft - January 2019

Rochdale and Oldham. Will ensure a more balanced pattern of growth across the north of GM

- **Wigan-Bolton Growth Corridor -** will complement the M62 North-East Corridor to ensure that there are significant investment opportunities across the northern areas, helping to boost the competitiveness of all parts of the north
- **Manchester Airport**

The strategic location boundaries are included on the SFRA Maps in Appendix A.

The first draft of the GMSF was consulted upon in 2016 and consultation responses highlighted several concerns. In particular in relation to the amount of greenfield land allocated for development purposes and the lack of affordable housing.

The GMSF has since been redrafted, in January 2019, with a focus on a brownfield first approach together with a new drive to protect the Green Belt. There is also a new priority on the town centres for more residential development.

Revised GMSF Strategic Objectives are set out in Table 5-1:

Table 5-1: GMSF Strategic Objectives (January 2019)

1) Meet our housing need by increasing the number of affordable homes with a diverse mix of housing.
2) Create neighbourhoods of choice by prioritising the use of brownfield land, primarily within town centres and close to public transport hubs, whilst ensuring no increase in homes at risk of flooding.
3) Ensure a thriving and productive economy i.e. by ensuring there is enough land to meet employment needs whilst also facilitating the development of high value employment such as advanced manufacturing; business and financial services; and healthcare innovations.
4) Maximise the potential arising from GM's national and international assets i.e. focusing on development in the Core Growth Area, Manchester Airport and other key economic locations; and improving City Centre visitor facilities.
5) Reduce inequalities and improve prosperity by ensuring access to skills training and employment opportunities; making the transport network more

accessible; and reducing the proportion of GM wards within the 10% most deprived nationally.

6) Promote the sustainable movement of people, goods, and information by improving the transport network; focusing new development near to transport hubs; and expanding the transport network to create new areas of sustainable growth.

7) Ensure GM is a more resilient and carbon neutral city-region.

8) Improve the quality of our natural environment and access to green spaces.

9) Ensure access to physical and social infrastructure i.e. by ensuring communities and businesses are supported by infrastructure; by improving the capacity of digital, energy, telecoms, transport and water; and ensuring new development is properly served by schools, health and social care and sports and recreation facilities.

The 2019 draft policy on 'Flood Risk and the Water Environment' (Policy GM-S 5) is detailed below in Figure 5-1. The policy focuses on a catchment-based approach.

Figure 5-1: Flood Risk and the Water Environment (Policy GM-S 5)

Policy GM-S 5

Flood Risk and the Water Environment

An integrated catchment based approach will be taken to protect the quantity and quality of water bodies and managing flood risk, by:

1. Returning rivers to a more natural state, where practicable, in line with the North West River Basin Management Plan;
2. Working with natural processes and adopting a natural flood management approach to slow the speed of water drainage and intercept water pollutants;
3. Locating and designing development so as to minimise the impacts of current and future flood risk, including retrofitting or relocating existing developments, infrastructure and places to increase resilience to flooding;
4. Expecting developments to manage surface water runoff through sustainable drainage systems and as close to source as possible (unless demonstrably inappropriate) so as to not exceed greenfield run-off rates or alternative rates specified in district local plans[39];
5. Ensuring that sustainable drainage systems:
    i. Are designed to provide multifunctional benefits wherever possible, including for water quality, nature conservation and recreation;
    ii. Avoid adverse impacts on water quality and any possibility of discharging hazardous substances to ground;
    iii. Are delivered in a holistic and integrated manner, including on larger sites split into different phases; and
    iv. Are managed and maintained appropriately to ensure their proper functioning over the lifetime of the development
6. Securing the remediation of contaminated land and the careful design of developments to minimise the potential for urban diffuse pollution to affect the water environment; and
7. Securing further investment in wastewater treatment to reduce the frequency of intermittent discharges of storm sewage.

5.1.1 Integrated Assessment

As part of the GMSF, an Integrated Assessment (IA) is being carried out, which involves:

- The Sustainability Appraisal (SA),
- The Strategic Environmental Assessment (SEA),
- The Equality Impact Assessment (EqIA),
- The Health Impact Assessment (HIA).

The structure of the IA is based upon the process contained in the Office of the Deputy Prime Minister (ODPM) best practice guidance from 2005 on SEA and Planning Practice Guidance on SEA and SA, updated in 2015.

Through integration of equalities and health considerations, the IA framework (the central component of the IA) ensures that all four assessment types are considered and completed.

The following sub-sections summarise the different elements being undertaken as part of the IA.

5.1.1.1 Sustainability Appraisal

The SA is a key component of the Local Plan evidence base (or the GMSF, in the case of GMCA), ensuring that sustainability issues are addressed during the preparation of local plans.

The SA is a technical document which must meet the requirements of the Strategic Environmental Assessment Directive 2001/42/EC which assesses and reports on a plan's potential impact on the environment, economy, and society.

The SA carries out an assessment of the draft policies at various stages throughout the preparation of the Local Plan. It does this by testing the potential impacts, and consideration of alternatives are tested against the plan's objectives and policies.

This ensures that the potential impacts from the plan on the aim of achieving sustainable development are considered, in terms of the impacts, and that adequate mitigation and monitoring mechanisms are implemented.

Paragraph 010 of the FRCC-PPG states that the SFRA should be used by a LPA to: "*inform the sustainability appraisal of the Local Plan, so that flood risk is fully taken into account when considering allocation options and in the preparation of plan policies, including policies for flood risk management to ensure that flood risk is not increased*."

5.1.1.2 Strategic Environmental Assessment

The SEA is a EU requirement that is designed to be integrated within Local Plans to provide a high level of protection of the environment by integrating

environmental considerations into the Local Plan process. Government has a SEA regulations requirements checklist available via: Strategic Environmental Assessment Regulations requirements checklist

5.1.1.3 Equality Impact Assessment

The EqIA is designed to ensure that discrimination does not occur in the drawing up of plans and policies, and that such plans or policies meet the requirements of equality legislation in the UK, most notably the Equality Act 2010. It is being used as part of the IA to add value and depth to the assessment process.

5.1.1.4 Health Impact Assessment

A HIA aims to ensure that plans and policies minimise negative and maximise positive health impacts. Consideration of the determinants of health and the broad requirements of the Department of Health HIA screening questions have been integrated into the IA Framework. As such, by including consideration of health, alongside the other environmental, sustainability and equality considerations, the GMSF IA covers the scope of a HIA.

6 Flood risks in Greater Manchester

6.1 Introduction

This section of the SFRA provides a strategic overview of flood risk from all sources within GM. The information contained is the best available at the time of publication and is intended to provide an overview of current and future flood risk.

6.2 Flood risk datasets

Table 6-1 provides a summary of the key datasets used in this SFRA according to the source of flooding.

Table 6-1: Flood source and key datasets

Flood source	Datasets / Studies
Fluvial	EA Flood Map for Planning (Rivers and Sea) (February 2018 version)
	EA Risk of Flooding from Rivers and Sea map (February 2018 version)
	Latest available EA Flood Risk Mapping studies - current and future fluvial. Future fluvial related to modelled climate change flood outlines as per the EA's 2016 allowances for peak river levels (see Section 6.9.2)
	Catchment Flood Management Plans (2009)
Pluvial (surface water runoff)	EA Risk of Flooding from Surface Water map (RoFSW)
	GM SWMP Hotspots dataset
	Critical Drainage Areas
	Opportunity Areas for Further Critical Drainage Management
	LLFA Preliminary Flood Risk Assessments
Sewer	UU historic hydraulic flooding incidents
	Critical Drainage Areas

Flood source	Datasets / Studies
	Opportunity Areas for Further Critical Drainage Management
	UU Drainage Area Zones
Groundwater	EA Source Protection Zones (note that SPZs relate to groundwater abstraction and may not give a particularly good indication of groundwater flood risk, particularly in areas where groundwater rebound is a problem)
Canal	Canal hazard mapping (previous SFRAs where available)
	Canal & River Trust overtopping and breach incidents
Reservoir	EA Reservoir Flood Maps (available online)
All sources	LLFA Local Flood Risk Management Strategies
	EA Historic Flood Map (HFM) (February 2018 version)
	EA Recorded Flood Outlines (RFO) (February 2018 version)
	LLFA historic flood incident registers, where available
	North West RBD Flood Risk Management Plan (2016)
	Previous local authority SFRAs
Flood risk management infrastructure	EA spatial flood defence data (February 2018 version)
	EA NFM / WwNP mapping
	Rivers Trust Irwell Catchment NFM mapping
	LLFA FRM asset register including critical condition assets

6.3 Fluvial flooding

Fluvial flooding is associated with the exceedance of channel capacity during higher flows. The process of flooding from watercourses depends on several characteristics associated with the catchment including:

- geographical location and variation in rainfall;
- steepness of the channel and surrounding floodplain; and
- infiltration and rate of runoff associated with urban and rural catchments.

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

Figure 6-1 shows the Main Rivers, and other rivers (non-main i.e. ordinary watercourses). The River Irwell is highlighted as the Irwell catchment, including tributaries, covers a significant area of GM, as mentioned in Section 4.2.4, and is therefore a strategically important watercourse for GMCA.

The Irwell tributaries include the rivers Spodden, Roch, Beal, Irk, Medlock and Croal. The MSC is also of strategic importance in that the risk associated with it is modelled by the EA and included within the Flood Map for Planning. The MSC drains the Irwell, Upper Mersey and Glaze Brook catchments thus has a significant influence on flood risk in GM.

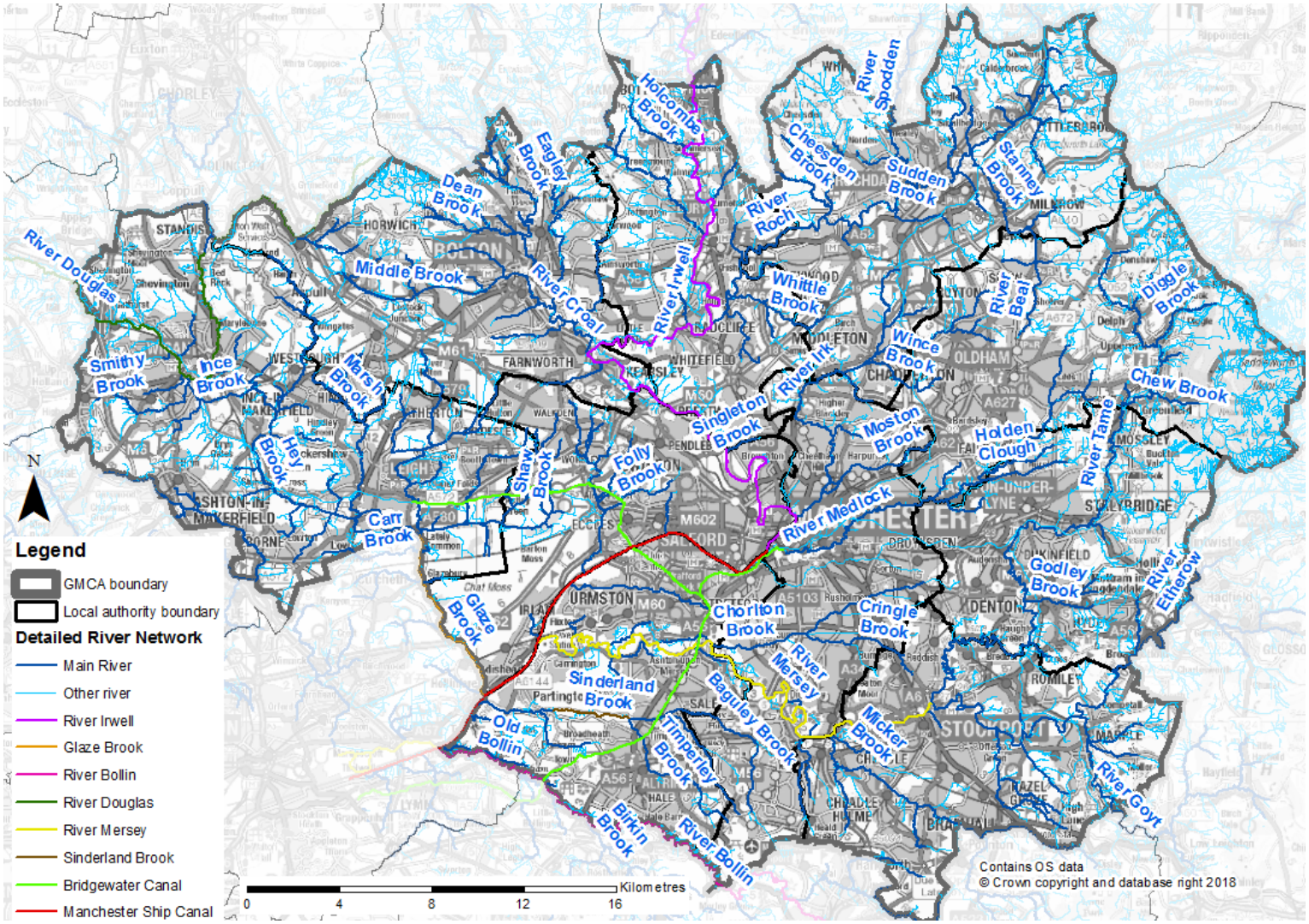
The other notable main rivers and their catchments include the Upper Mersey catchment, which covers a significant area of southern GM, including the main rivers of the rivers Mersey, Tame, Goyt and Etherow.

The River Douglas catchment in Wigan and Bolton includes the Main River tributaries of Smithy Brook and Ince Brook.

The Glaze Brook catchment drains large parts of Wigan including the main rivers Hey Brook and Carr Brook whilst the Glaze Brook tributary of Shaw Brook drains parts of Salford.

The smaller Main River catchments of the River Bollin and Sinderland Brook are in the south of GM draining parts of Manchester, Trafford and Stockport.

Figure 6-1: Main Rivers and other rivers in GM



6.3.1 Main River

The EA decides which watercourses are Main Rivers. It consults with other RMAs and the public before making these decisions.

The EA describes Main Rivers as usually being larger rivers and streams with other rivers known as ordinary watercourses. The EA carries out maintenance, improvement, or construction work on Main Rivers to manage flood risk and will carry out flood defence work to Main Rivers only.

6.3.2 Ordinary watercourses

Ordinary watercourses are any watercourse not designated as Main River. These watercourses can vary in size considerably and can include rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows.

LLFAs, district councils and internal drainage boards carry out flood risk management work on ordinary watercourses.

6.3.3 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 (from Main River) and tidal flooding. This is supported by the CFMPs and FRMPs along with several detailed hydraulic river modelling reports which provide further detail on flooding mechanisms. There is no tidal flood risk within GM.

The Flood Map for Planning provides flood extents for the 1 in 100 AEP fluvial event (Flood Zone 3), the 1 in 200 AEP tidal event (also 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 fluvial and tidal, and do not take account of climate change. Climate change is covered in Sections 6.9 and 7.3.3.

As directed by the FRCC-PPG, this SFRA subdivides Flood Zone 3 into Flood Zone 3a and Flood Zone 3b (functional floodplain - see Section 6.3.4).

The EA also provides a 'Risk of Flooding from Rivers and Sea Map'. This map shows the EA's assessment of the likelihood of flooding from rivers and the sea, at any location, and is based on the presence and effect of all flood defences, predicted flood levels and ground levels.

This dataset is not used in the assessment of flood risk for planning applications but is a useful source of information to show the presence and effects of flood risk management infrastructure. This dataset is further discussed in Section 6.3.5.

This SFRA uses the Flood Map for Planning version issued in February 2018 to assess fluvial risk to potential development sites, as per the NPPF and the accompanying FRCC-PPG (see Appendix B and C for the details on the sites assessment).

The Flood Map for Planning is updated at quarterly intervals by the EA, as and when new modelling data becomes available. The reader should therefore refer to the online version of the Flood Map for Planning to check whether the flood zones may have been updated since February 2018: Flood Map for Planning

6.3.3.1 Flood Zone 3 in GM

Figure 6-2 presents a small-scale map of Flood Zone 3. It provides a high-level view of the areas of GM within Flood Zone 3 and therefore those areas considered to be at significant risk from fluvial flooding, not accounting for flood defence infrastructure.

Visually, the districts of Manchester, Trafford, Wigan, Bolton and Rochdale appear to have the most risk. The large areas of Flood Zone 3 apparent in these districts, indicated on Figure 6-2 by green circles, are summarised in Table 6-2.

The smaller red circles highlight the locations of existing residential development that are within Flood Zone 3 and therefore at significant risk. Table 6-3 lists these locations. Table 6-3 does not list all residential areas, only those where there are a significant number of properties at risk.

The River Mersey and River Irwell have a significant effect on flood risk in GM. In contrast to the Irwell, the large areas of risk from the Mersey tend to cover what would be natural floodplain were it not for the flood defence embankments in place to protect the areas that are used for golf courses or have other commercial / leisure uses. Risk from the Irwell affects several residential areas in Salford, Manchester and further upstream in Bury.

15 residential areas of Wigan are shown to have considerably sized residential areas within Flood Zone 3 whilst there are seven in Manchester; six in Bolton; five in Rochdale; four in Stockport; three in Bury and Trafford; two in Oldham and Tameside; and one in Salford.

The residential area at risk in Salford is large and includes much of Lower Broughton and Lower Kersal that are shown to be at risk from the River Irwell.

A key location shown to be at risk is Rochdale Town Centre. The River Roch is shown to come out of bank through much of the Town Centre and also upstream in the town of Littleborough.

Another key location includes that of Brunswick and Hume, just south of Manchester City Centre. The risk here all comes from Corn Brook which is concealed underground. There are likely to be considerable capacity issues within this constrained underground channel.

Figure 6-2: Flood Zone 3 across GM

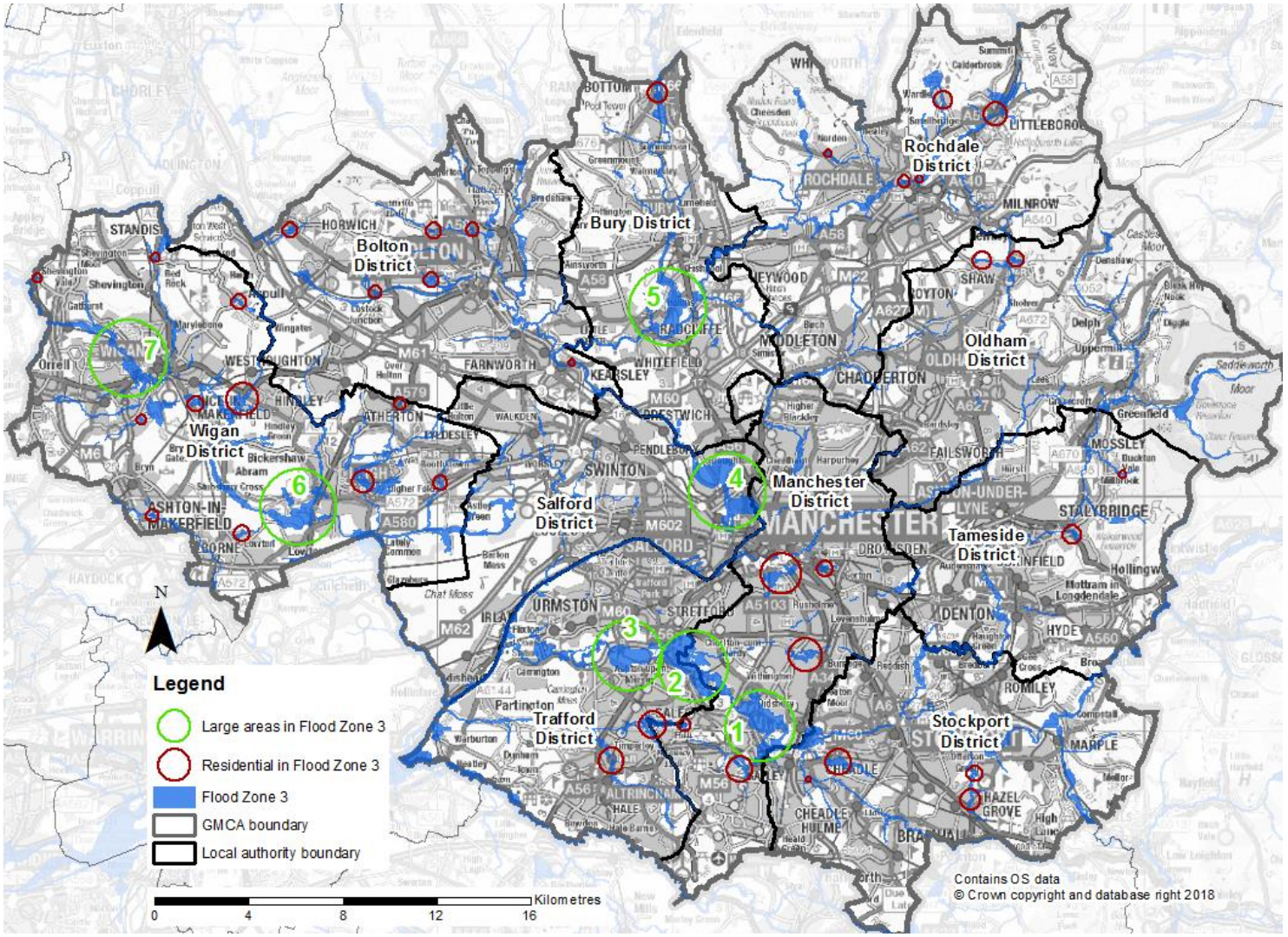


Table 6-2: Areas of considerable fluvial risk in GM

Reference to Error! Not a valid result for table.	District	Location	Watercourse	Land use at risk
1	Manchester	Between Didsbury and Northenden	River Mersey	Mainly undeveloped land; M60 and M56 motorways; other roads; developed parts of Sharston
2	Manchester; Trafford	Between Chorlton-cum-hardy and Sale	River Mersey	Undeveloped land; minor roads
3	Trafford	North Sale and Ashton upon Mersey	River Mersey and Stromford Brook	Undeveloped land; residential areas of Sale and Ashton upon Mersey
4	Salford; Manchester	Lower Broughton; Lower Kersal	River Irwell	Residential areas; roads
5	Bury	Redvales; Barlow Fold	River Irwell	Residential areas; roads; undeveloped land
6	Wigan	Plank Lane; Firs Lane; Pennington	Hey Brook; Westleigh Brook; Common Lane Brook	Residential; roads; undeveloped land
7	Wigan	Wallgate; Newtown	River Douglas	Non-residential; undeveloped land

Table 6-3: Existing residential areas within Flood Zone 3

District	Location	Watercourse
Manchester	Sharston	River Mersey; culverted ordinary watercourse
	Northern Moor	Baguley Brook
	Fallowfield	Cringle Brook; Leigh Brook (culverted)
	Brunswick/Hulme	Corn Brook (underground)
	West Gorton	Corn Brook (underground)
Manchester; Trafford	Brooklands	Baguley Brook; Fairywell Brook
Trafford	Altrincham	Timperley Brook
Salford	Lower Broughton	River Irwell
	Lower Kersal	River Irwell
Wigan	Worthington	River Douglas
	Bolton Road culvert	Culverted Main River
	Hawkley	Hawkley Brook (culverted)
	Spring View	Ince Brook
	Hindley	Borsdane Brook; Dog Pool Brook; Hockery Brook (culverted)
	Ashton	Millingford Brook; Jack Brook (culverted)
	Lowton	Crow Wood Avenue (culverted); ordinary watercourse (culverted)
	Lilford	Lilford Park Brook/Atherton Lake Brook
	Blackmoor	Ellenor Brook
	Atherton	Carr Brook

District	Location	Watercourse
Bolton	Horwich	Pearl Brook (culverted); Pearl Brook Tributary (culverted)
	Lostock	Bessy Brook (culverted)
	Heaton	Culverted Main River
	Smithills	Dean Brook; Dean Brook (culverted)
	Sharples / Astley Bridge	Culverted Main River; Astley Brook
	Prestolee	River Irwell
Rochdale	Littleborough	River Roch
	Wardle	Wardle Brook (partially culverted)
	Newbold Brow	River Roch
	Town Centre	River Roch
	Norden	Caldershaw Brook (culverted)
Stockport	Hazel Grove	Unnamed Main River
	North of Hazel Grove	Poise Brook
	Cheadle	Chorlton Brook
	Wilmslow Road (Cheadle)	Micker Brook; ordinary watercourse
Oldham	Lower Rushcroft	Culverted Main River
	Goats	Old Brook; River Beal
Tameside	Carrbrook	Ordinary watercourse (partially culverted)
	Fernbank/Copley	Culverted Main River
Bury	Ramsbottom	River Irwell

6.3.4 Functional Floodplain (Flood Zone 3b)

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

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

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

Paragraph 015 of the FRCC-PPG explains that

"*…the identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood (such as a flood attenuation scheme) in an extreme (0.1% annual probability) flood, should provide a starting point to help identify the functional floodplain.*

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

To map the functional floodplain outline as part of this SFRA, a GIS exercise was carried out whereby all existing functional floodplain outlines from each LPA were appended together to form one outline covering GM. This appended outline was then updated using up-to-date data.

The methodology is described in a technical note (Appendix D) for each LPA explaining the methodology used in updating the functional floodplain outline.

The methodology remains consistent across all ten LPAs to produce one robust functional floodplain for all of GM and not separately for each GM LPA.

The outline has been subject to scrutiny and review, before being agreed upon, by the LPAs, the LLFAs and the EA, based on their local knowledge. Any future Level 2 SFRAs or site-specific FRAs should further assess the areas of functional floodplain through detailed investigation and assessment of the actual risk and extent of the functional floodplain.

The final functional floodplain outline for GM is displayed on the SFRA Maps in Appendix A and is to be used by GMCA for strategic planning and the LPAs for development management.

6.3.5 EA Risk of Flooding from Rivers and the Sea Map

This Risk of Flooding from Rivers and Sea map (RoFRS) shows the likelihood of flooding from rivers and the sea based on the presence and effect of all flood defences, predicted flood levels and ground levels and is shown on the Appendix A maps.

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

- High – greater than or equal to 1 in 30 (3.3%) chance in any given year
- Medium – less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance in any given year
- Low – less than 1 in 100 (1%) but greater than or equal to 1 in 1,000 (0.1%) chance in any given year
- Very Low – less than 1 in 1,000 (0.1%) chance in any given year

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

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

6.4 Surface water flooding

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

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

There are certain locations, generally within urban areas, where the probability and consequence of pluvial and sewer flooding are more prominent due to the complex hydraulic interactions that exist in the urban environment.

Urban watercourse connectivity, sewer capacity, and the location and condition of highway gullies all have a major role to play in surface water flood risk.

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.

Paragraph 013 of the FRCC-PPG states that SFRAs should address surface water flooding issues by identifying areas of surface water flooding and areas where there may be drainage issues that can cause surface water flooding.

The RoFRS map along with the LFRMS should assist with this and various mitigative measures, i.e. SuDS, should be identified. Sections □ to 7.11 provide guidance on mitigation options and SuDS for developers.

6.4.1 Pluvial flooding

Pluvial flooding of land from surface water runoff is usually caused by intense rainfall that may only last a few hours. In these instances, the volume of water from rural land can exceed infiltration rates in a short amount of time, resulting in the flow of water over land.

Within urban areas, this intensity can be too great for the urban drainage network resulting in excess water flowing along roads, through properties and ponding in natural depressions. Areas at risk of pluvial flooding can, therefore, lie outside of the fluvial or tidal flood zones of the Flood Map for Planning.

Pluvial flooding within urban areas across the country will typically be associated with events greater than the 1 in 30 year design standard of most new sewer

systems. Some older sewer and highway drainage networks will have a lower capacity than what is required to mitigate for the 1 in 30 year event.

There is also a residual risk associated with these networks due to possible network failures, blockages or collapses.

6.4.1.1 Risk of Flooding from Surface Water

Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

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

The RoFSW, used in this SFRA to assess risk from surface water, has proved extremely useful in supplementing the EA Flood Map for Planning by identifying areas in Flood Zone 1 that may have critical drainage problems.

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

- 1 in 30 AEP event (high risk)
- 1 in 100 AEP event (medium risk)
- 1 in 1000 AEP event (low risk)

The RoFSW is much more refined than the second-generation map in that:

- More detailed hydrological modelling has been carried out using several design rainfall events rather than one for the second generation,
- A higher resolution Digital Terrain Model (DTM) has been used – 2 m, compared to 5 m for the second generation,
- Manual edits of DTM to improve flow routes at over 91,000 locations compared to 40,000 for the second generation,
- DTM edited to better represent road network as a possible flow pathway, this was not done for the second generation,

- Manning's n roughness (used to represent the resistance of a surface to flood flows in channels and floodplains) values varied using the MasterMap Topography layer compared to blanket values for urban and rural land use applied in the second generation surface water flood map.

The RoFSW does not contain sufficient information for it to be used to determine flood risk to individual properties or potential development sites. However, it does give an indication of whether an area may be affected by surface water flooding and to what extent.

The RoFSW is displayed on the SFRA Maps.

6.4.1.2 Surface water flood risk in GM

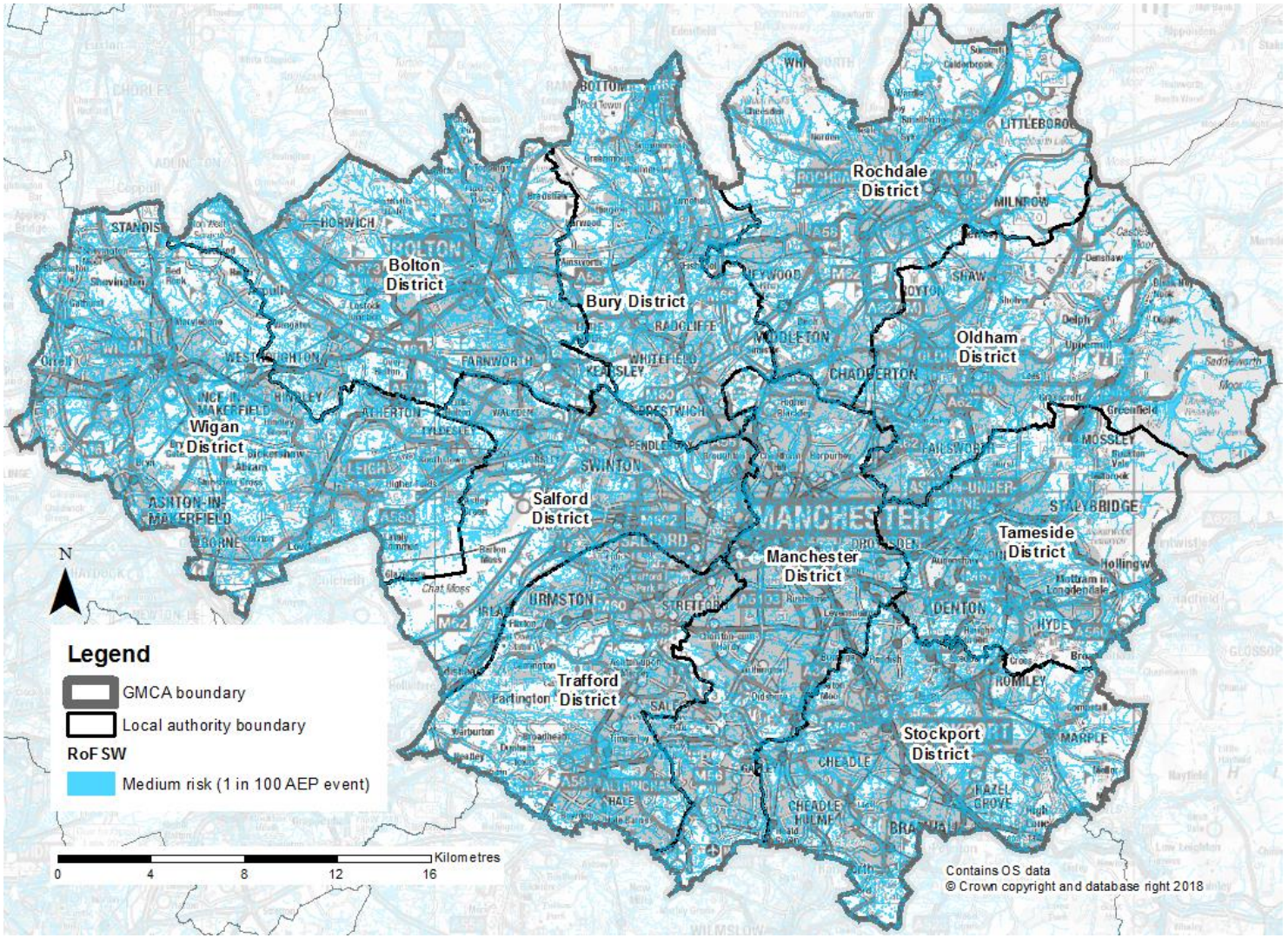
Figure 6-3 shows a small-scale map of the medium risk 1 in 100 AEP event of the RoFSW dataset. Visually, the majority of urban GM is at risk from surface water flooding, according to the RoFSW.

Only the upland areas of the north and east of GM i.e. in Bury, Rochdale, Oldham, Tameside and Stockport are not covered in 'the blue' of surface water flood risk. Surface water flood risk is clearly therefore an issue for all of GM, according to the RoFSW.

The RoFSW is however a national broad scale dataset therefore more detailed surface water / drainage modelling may be required at the community or development level.

In order to narrow down and focus on urban areas at particularly significant surface water flood risk, CDAs were mapped, as part of previous GM SFRAs. OAFCDMs have also been mapped as part of this GMCA SFRA using UU DAZ boundary data and historic records of surface water flooding as discussed in Sections 4.7.3 and 6.4.3.

Figure 6-3: Surface water flood risk across GM (RoFSW 1 in 100 AEP event)



6.4.2 Sewer flooding

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 large surface water systems during periods of high flows.

Some areas may also be served by separate waste and surface water sewers that convey wastewater to treatment works and surface water into local watercourses.

Flooding from the sewer network mainly occurs when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity. The system then 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 can 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.

UU is the water company responsible for the management of most of the drainage network across GM.

6.4.3 Areas with Critical Drainage Problems, Critical Drainage Areas and Opportunities for Further Critical Drainage Management

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

management measures are incorporated into new development to help mitigate fluvial flood risk.

EA guidance on carrying out Flood Risk Assessments[19] states that a FRA should be carried out for sites in Flood Zone 1 that are…

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

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

As discussed in Section 4.7.3, CDAs can be designated by LPAs or LLFAs for their own purposes. The EA do not have to be consulted on sites that are within a CDA if such sites are in Flood Zone 1.

Opportunity Areas for Further Critical Drainage Management (OAFCDM) have been drafted as part of this SFRA using:

- UU DAZ data,
- surface water flood 'Hotspots' generated from the 2013 GM SWMP and
- historical surface water flooding data provided by the LLFAs and UU.

The OAFCDMs are listed in Table 6-4 along with the Wastewater Treatment Works (WwTW) that the area covered by each OAFCDM is drained by.

19 Flood risk assessment in flood zone 1 and critical drainage areas

Figure 6-4 shows a GM scale map of the OAFCDM boundaries. The OAFCDM s along with the CDAs are also included on the SFRA Maps in Appendix A.

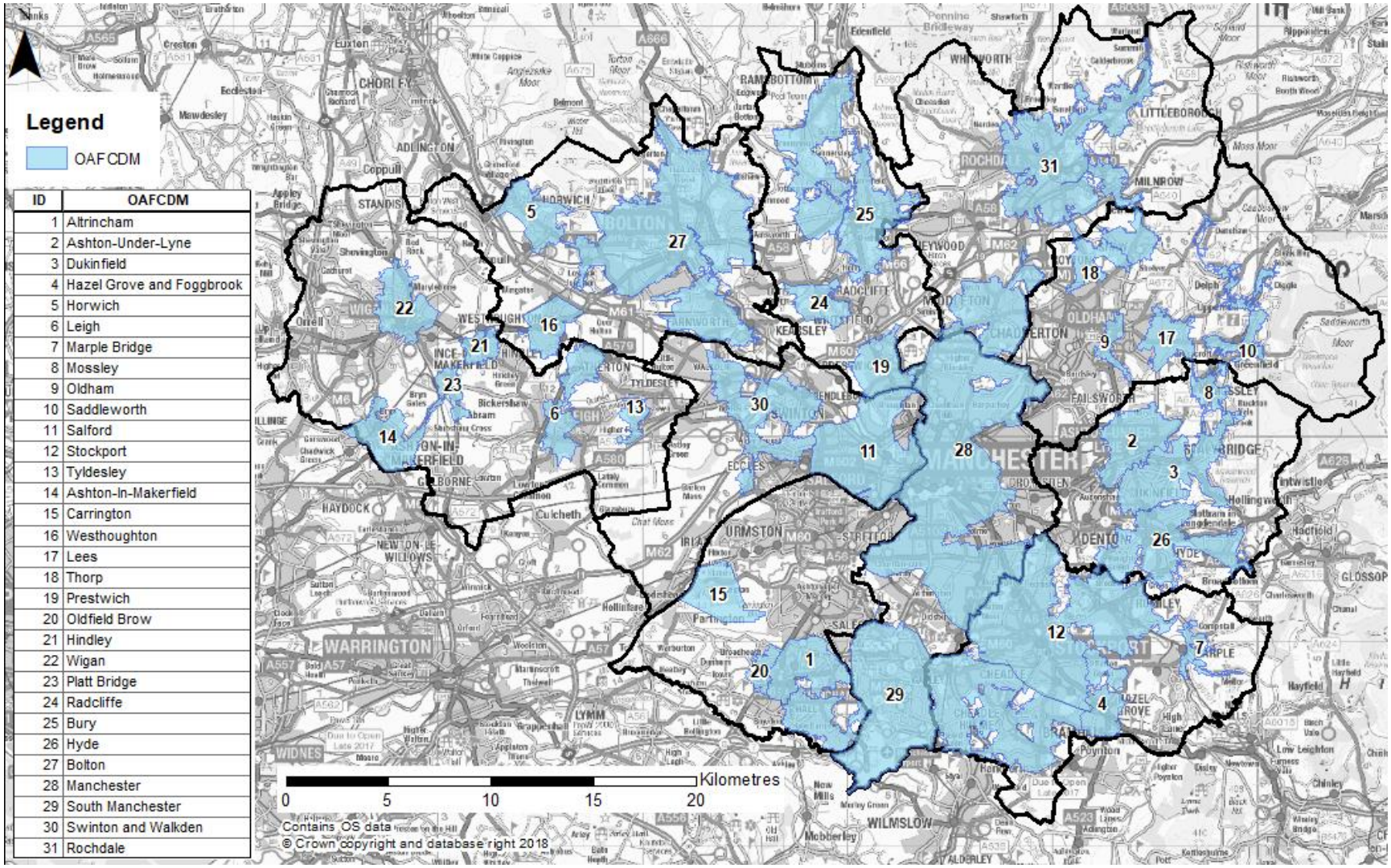
No policy is attached to the OAFCDMs, though the councils should use them alongside the CDA boundaries to possibly extend CDA policy into the OAFCDMs if thought to be beneficial.

Table 6-4: Opportunity Areas for Further Critical Drainage Management

OAFCDM name	WwTW	GM Authority
Altrincham	ALTRINCHAM WwTW	Trafford
Ashton-Under-Lyne	ASHTON-U-LYNE WwTW	Tameside
Dukinfield	DUKINFIELD WwTW	Tameside
Hazel Grove and Foggbrook	HAZEL GROVE WwTW	Stockport
Horwich	HORWICH WwTW	Bolton
Leigh	LEIGH WwTW	Wigan
Marple Bridge	LOW MARPLE WwTW	Stockport
Mossley	MOSSLEY WwTW	Tameside
Oldham	OLDHAM WwTW	Oldham
Saddleworth	SADDLEWORTH WwTW	Oldham
Salford	SALFORD WwTW	Salford
Stockport	STOCKPORT WwTW	Stockport
Tyldesley	TYLDESLEY WwTW	Wigan
Ashton-In-Makerfield	WARRINGTON NORTH WwTW	Wigan
Carrington	DAVYHULME WwTW	Trafford
Westhoughton	WESTHOUGHTON WwTW	Bolton
Lees	OLDHAM WwTW	Oldham
Thorp	ROYTON WwTW	Oldham

OAFCDM name	WwTW	GM Authority
Prestwich	BOLTON WwTW	Bury
Oldfield Brow	DUNHAM MASSEY WwTW	Trafford
Hindley	WIGAN (HOSCAR) WwTW	Wigan
Wigan	WIGAN (HOSCAR) WwTW	Wigan
Platt Bridge	WIGAN (HOSCAR) WwTW	Wigan
Radcliffe	BOLTON WwTW	Bury
Bury	BURY WwTW	Bury
Hyde	HYDE WwTW	Tameside
Bolton	BOLTON WwTW	Bolton
Manchester	DAVYHULME WwTW	Manchester; Rochdale
South Manchester	DAVYHULME WwTW	Stockport; Manchester; Trafford
Swinton and Walkden	ECCLES WwTW	Salford
Rochdale	ROCHDALE WwTW	Rochdale; Oldham

Figure 6-4: Mapped OAFCDMs



ID	OAFCDM
1	Altrincham
2	Ashton-Under-Lyne
3	Dukinfield
4	Hazel Grove and Foggbrook
5	Horwich
6	Leigh
7	Marple Bridge
8	Mossley
9	Oldham
10	Saddleworth
11	Salford
12	Stockport
13	Tyldesley
14	Ashton-In-Makerfield
15	Carrington
16	Westhoughton
17	Lees
18	Thorp
19	Prestwich
20	Oldfield Brow
21	Hindley
22	Wigan
23	Platt Bridge
24	Radcliffe
25	Bury
26	Hyde
27	Bolton
28	Manchester
29	South Manchester
30	Swinton and Walkden
31	Rochdale

6.4.4 Locally Agreed Surface Water Information

EA guidance on using surface water flood risk information recommends that the LLFA, should:

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

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

Locally agreed surface water information either consist 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.

Each GMCA LPA should consider the RoFSW to be its locally agreed surface water flood information as this is the latest, most robust surface water flood map available for GM.

6.5 Groundwater flooding

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 and the sea, 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 SuDS; however, this is dependent on detailed site investigation and risk assessment at the FRA stage.

The EA has produced a guidance document which may be used by developers and homeowners to help reduce the impacts caused to property by groundwater flooding: Flooding from Groundwater: Practical advice to help you reduce the impact of flooding from groundwater

Detailed groundwater information has not been made available for this SFRA. Groundwater information will be very localised and may differ significantly across GM. EA Source Protection Zones have been assessed, however.

6.5.1 Source Protection Zones (SPZ)

The EA has defined SPZs for groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk.

The EA uses the zones in conjunction with the Groundwater Protection Policy to set up pollution prevention measures in areas which are at a higher risk, and to monitor the activities of potential polluters nearby.

This includes consideration of new development which can have major impacts on the groundwater source.

The SPZ maps show three main zones: namely, the inner, outer and total catchment zones:

Zone 1 - Inner Protection Zone

Zone 1 is closest to the site of the well or borehole and therefore the area of highest risk to the groundwater source.

This zone is designed to protect against the effects of human activities which might affect the groundwater source.

Zone 1 is defined by a 50 day travel time from any pollution below the water table to the groundwater source and has a minimum radius of 50 m around the source.

The 50 day travel time is based on the time it takes some biological contaminants to decay.

Zone 2 - Outer Protection Zone

Zone 2 is defined by a 400 day travel time from any pollution below the water table to the groundwater source.

This travel time is the minimum period over which the EA considers that pollutants need to be diluted, reduced in strength, or delayed by the time they reach the source.

SPZ 2 is defined as the minimum recharge area required to support 25% of the protected yield and has a minimum radius of 250-500 m around the groundwater source, depending on the size of the abstraction.

Zone 3 - Total Catchment Zone / Final Source Catchment Protection Zone

Zone 3 is defined as the area around a groundwater source within which all groundwater recharge is presumed to be discharged at the abstraction source.

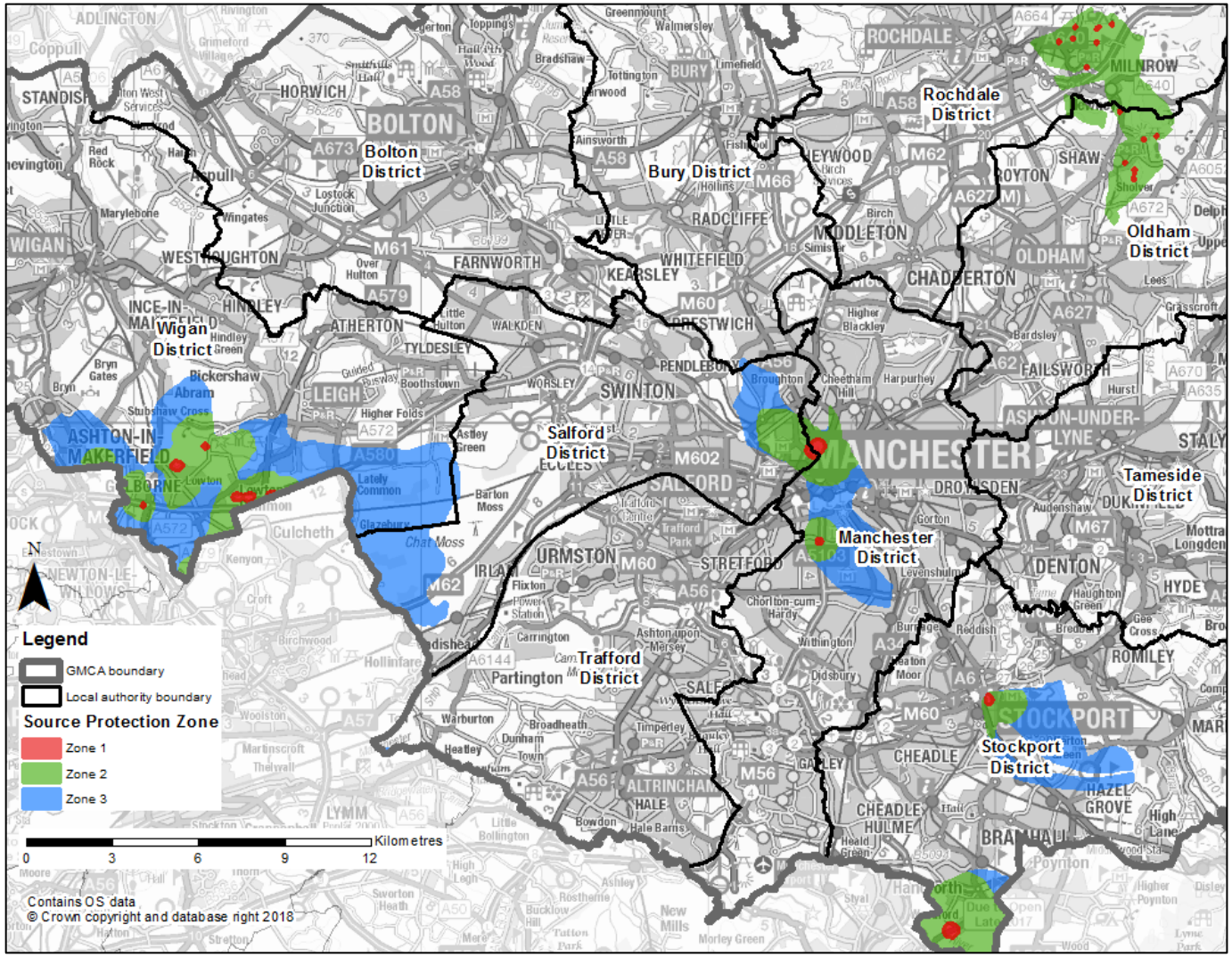
This zone largely depends on the volume abstracted and the effective rainfall. It covers the whole of the catchment area of a source based on the area needed to maintain abstraction if all water will eventually reach the abstraction point. For heavily exploited aquifers, Zone 3 can be defined as the whole aquifer recharge area.

Figure 6-5 shows the SPZs in GM with Wigan, Salford, Manchester, Stockport, Rochdale and Oldham the districts containing SPZs.

The EA doesn't permit the mapping of SPZs on any scale Ordnance Survey map greater than 1:50,000, as the data was only modelled to this level and is not considered accurate beyond this scale.

The SPZs have therefore not been included on the SFRA Maps in Appendix A.

Figure 6-5: SPZs in GM



6.6 Canal and reservoir flood risk

6.6.1 Canals

The risk of flooding along 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 6-5.

Canals can also have a significant interaction with other sources, such as watercourses that feed them and minor watercourses or drains that cross underneath.

Table 6-5: Canal flooding mechanisms

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

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

The pound length of the canal also increases the consequence of failure, as flows will only cease due to the natural exhaustion of supply. Stop plank[20] (log) arrangements, stop gates and the continued inspection and maintenance of such assets by the Canal & River Trust help to manage the overall risk of a flood event.

A considerable canal network runs through GM that is owned and maintained by the Canal & River Trust. Such canals include the:

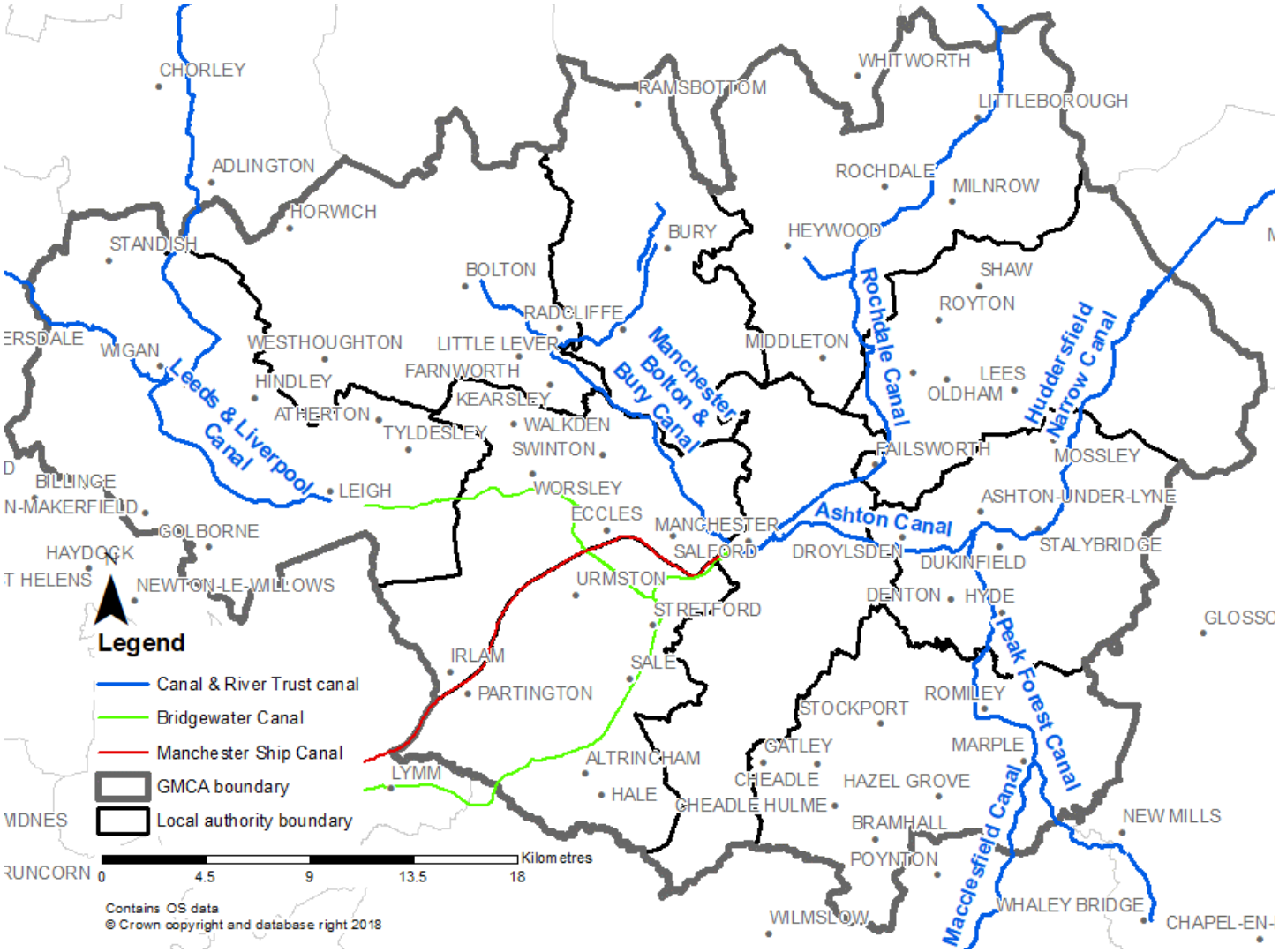
- Leeds Liverpool Canal,
- Manchester, Bolton and Bury Canal,
- Rochdale Canal,
- Ashton Canal,
- Huddersfield Narrow Canal,
- Peak Forest Canal and
- the Macclesfield Canal.

The MSC and the Bridgewater Canal, however, are privately owned by the Peel Group. Due to the risks associated with the MSC the EA incorporates it into the Flood Map for Planning.

The canal network is shown below on Figure 6-6 and also on the SFRA Maps which also include available modelled canal hazard zones for selected canals, as described below in Section 6.6.1.1.

20 Wooden boards for dropping into grooves at a narrows; to permit drainage for maintenance work on a canal section or to isolate a leaking section

Figure 6-6: GM canal network



6.6.1.1 Canal flood hazard zones

The previous combined Bury, Rochdale, Oldham Level 1 SFRA (2009); Oldham Level 2 SFRA (2010); Wigan Level 2 SFRA (2010); and combined Manchester, Salford and Trafford (MST) Level 2 SFRA (2011) assessed potential flood risk associated with canals.

These SFRAs assessed risk from the following canals:

- Bridgewater Canal;
- Rochdale Canal;
- Ashton Canal; and
- Huddersfield Narrow Canal.

Bridgewater Canal

The MST SFRA produced canal overtop hazard zones and canal breach hazard zones for targeted locations along the Bridgewater, Rochdale and Ashton canals. The risk of flooding from the Bridgewater Canal is higher than that from the Ashton and Rochdale canals, since it receives natural inflows from the River Medlock. There is hydraulic connection between the River Medlock and the Bridgewater Canal.

An estimation of the potential flow along the canal is relevant when estimating the overtopping risk from the Bridgewater Canal. The greater the potential flow, the greater is the potential for overtopping and consequent flood risk. For the Bridgewater Canal some estimation of flood conditions can be made because of the influence of the River Medlock.

The upstream part of the canal is likely to be the most heavily affected by the River Medlock; however, after the canal splits at Stretford the impact will be rapidly reduced as the flood wave dissipates in two directions.

For extreme flood events, water levels in the MSC may also have some impact on water levels in the Bridgewater Canal.

Overtopping zone

In locations where surrounding ground levels (using LIDAR) are the same as or lower than canal level water levels, flooding from canal overtopping was

considered to be possible. HEC-RAS software was used to model a possible overtopping of the Bridgewater Canal. Two spill overflow hydrographs were measured at the two extreme ends of the canal model in order to represent the potential overtopping in two sections of the canal:

- the upstream section which is immediately fed by the River Medlock and
- the sections downstream of the split at Stretford.

Only the upstream section of the canal, where the overflow was significant, was then modelled using two-dimensional hydraulic software to produce a canal overtopping zone for this section of canal, south west of Salford Quays and Ordsall. This overtopping hazard zone is shown on the SFRA Maps.

The low flows recorded at the downstream end of the model confirm that the flood wave from the River Medlock would be expected to dissipate and that, although overtopping in this section of the canal is possible, the risk is likely to be much lower.

The reduced hydrograph yields a flood volume that would be small compared to likely surface water runoff volumes in an actual storm event. Hence, for this section of the canal, the surface water flood maps (now the RoFSW dataset) are perhaps the best indicator of the locations of low embankments and where flood water could overtop the canal bank.

Those considering development in the vicinity of canals should refer to this zone in the first instance in order to assess whether flood risk from canal overtopping should be included within a FRA. If the development is within the zone, then the developer will need to quantify this risk. In some cases, this may simply mean that some topographic survey of the local area is required, which may indicate that overtopping at the specific site under consideration is highly unlikely.

Breach zone

Canal breaches can be caused by overtopping of the canal embankments and erosion of the embankment face. In general, they are more commonly caused by failure of the canal lining and erosion within the embankment slope until failure occurs.

Flooding from a breach of a canal embankment is largely dictated by canal and ground levels, canal embankment construction, breach characteristics and the volume of water within the canal that can discharge into the lower lying areas behind any breach.

Possible breach locations were identified using a conservative approach. Areas in the vicinity of the canal that are more than approximately 0.3 m lower than the estimated canal water level were assumed to be at potential risk from a canal breach. Canal water levels and hinterland levels were determined using LIDAR data.

A breach hydrograph was fed into the two-dimensional JFLOW model to assess flood inundation extents along the length of the canal. Inflows were included in the JFLOW model at 100 m intervals along the canal at potential breach locations. The modelled extents from the individual inflows were combined, with a small buffer zone, to provide a canal breach hazard zone for the Bridgewater Canal.

The potential breach locations / areas were then sub-divided into two Canal Breach Zones (each shown on the SFRA Maps):

- Zone A - those areas that would be affected by a breach of an embankment. In this zone a detailed examination of canal breach flood risks is required.
- Zone B - less likely breach locations, such as at wide, low or very low embankments. At such locations it is more likely that this source of risk could be scoped out within any site-specific FRA.

Breach Zone A on the Bridgewater Canal covers several developed areas in Salford, namely; Alder Forest Westwood Park, Winton, Dumplington, Stretford, Sale, Timperley and Old Trafford.

Rochdale and Ashton canals

Overtopping zone

The Rochdale and Ashton Canal are controlled waterbodies and generally the overtopping risk was considered to be low. However, historic canal bank

overtopping has been recorded on the Rochdale Canal at Holland Street and it was considered that this area warranted a more detailed assessment.

British Waterways were able to advise that the overtopping in the area was caused by lowered freeboards from mining subsidence along the pound stretching, approximately, from Butler Street to Great Ancoats Street.

The modelled flow hydrograph output was distributed for spill locations at Holland Street in a two-dimensional JFLOW model where ground levels are lower than the canal water level. The resultant flood extents were combined with a 5 metre buffer zone to produce an Overtopping Hazard Zone for the Rochdale Canal at Holland Street, as shown on the SFRA Maps.

Breach zone

Compared to the Bridgewater Canal, the pound lengths for the Rochdale and Ashton canals are much shorter and therefore the available flood volume is much smaller. In breach conditions it was considered likely that only a single pound length would be likely to drain.

The actual volume of water leaving a canal after a breach has occurred would in practice be dependent on the local pound length, which varies throughout the canal network.

As part of the MST SFRA, a breach hydrograph was developed using a one-dimensional HECRAS model with an average pound length of 1.3 km applied to the model. Breach hydrographs were fed into a two-dimensional JFLOW model to assess potential flood inundation extents as per the Bridgewater Canal method.

The Oldham Level 2 SFRA modelled breach locations on the Rochdale Canal within the Oldham authority area and produced a Canal Hazard Zone (shown on the SFRA Maps).

It was found that the locations where canal breaches are most likely to occur are:

- The lower lying areas of Chadderton and Failsworth;
- The aqueduct across the River Irk (breaches have occurred in 1923 and 2003;
- Surrounding farmland.

As with the Bridgewater Canal, Hazard Zones A and B have also been produced for the Rochdale and Ashton canals. Zone A covers a large part of Ancoats in Manchester City Centre.

Huddersfield Narrow Canal

A Canal Hazard Zone was also produced for the Huddersfield Narrow Canal in Oldham (see SFRA Maps). It was found that:

- A breach of raised embankments would result in canal flood water flowing towards the River Tame and southwards along the Tame Valley;
- Immediately downstream of the Standedge Tunnel, at Diggle Works, the canal passes approximately 9 metres above Diggle Brook. A breach in this location would result in large volumes of water entering Diggle Brook;
- A breach in Uppermill could cause flooding to areas between the canal and the River Tame, Churchill fields, parts of Frenches Wharf and the sewage works at Greenfield.

6.6.2 Reservoirs

A reservoir can usually be described as an artificial lake where water is stored for use. Some reservoirs supply water for household and industrial use, others serve other purposes, for example, as fishing lakes or leisure facilities.

Like canals, the risk of flooding associated with reservoirs is residual and is associated with failure of reservoir outfalls or breaching. This risk is reduced through regular maintenance by the operating authority.

Reservoirs in the UK have an extremely good safety record with no incidents resulting in the loss of life since 1925.

The EA is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be regularly inspected and supervised by reservoir panel engineers. LAs are responsible for coordinating emergency plans for reservoir flooding and ensuring communities are well prepared.

GMCA should work with other members of the Greater Manchester Resilience Forum (GMRF) to develop these plans. See Section 8.1.1 for more information on the GMRF.

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

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

There are several reservoirs located across GM and also outside of GM which may have an effect on risk to communities in GM.

6.6.3 Reservoir Flood Maps

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 meters of water).

The FWMA updated the Reservoirs Act and targeted a reduction in the capacity at which reservoirs should be regulated from 25,000m³ to 10,000m³. 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.

The maps were originally produced for Local Resilience Forums to use for emergency planning, however The Pitt Review, 2007, recommended that the maps be made available to the public online as part of wider flood risk information.

The maps show the largest area that might be flooded if a reservoir were to fail and release the water it holds, including information about the depth and speed of the floodwaters.

In September 2016, the EA produced a RFM guide ' Explanatory Note on Reservoir Flood Maps for Local Resilience Forums – Version 5[21]' that provides information on how the maps were produced and what they contain.

21 Reservoir Flood Map Guide

The RFM outlines are included on the SFRA Maps (Appendix A), however they can also be viewed online at: Reservoir Flood Map

The RFM shows that a there are several large reservoirs / impounded waterbodies within GM that may affect populated areas, in the unlikely event of a breach. Manchester, including the City Centre, and the town centres of Wigan, Bury and Bolton could be significantly flooded were a dam breach to occur at certain upstream reservoirs in GM.

6.7 Historic flooding

As stated in Table 4-1, under the FWMA, LLFAs are required to investigate and record details of what are considered to be locally significant flood events within their areas.

Records should be stored as part of a digital database or spatial GIS dataset which can be mapped. The records should contain details such as:

- date and time;
- flood source;
- location;
- people, property or infrastructure affected;
- RMA response; and
- works carried out afterwards.

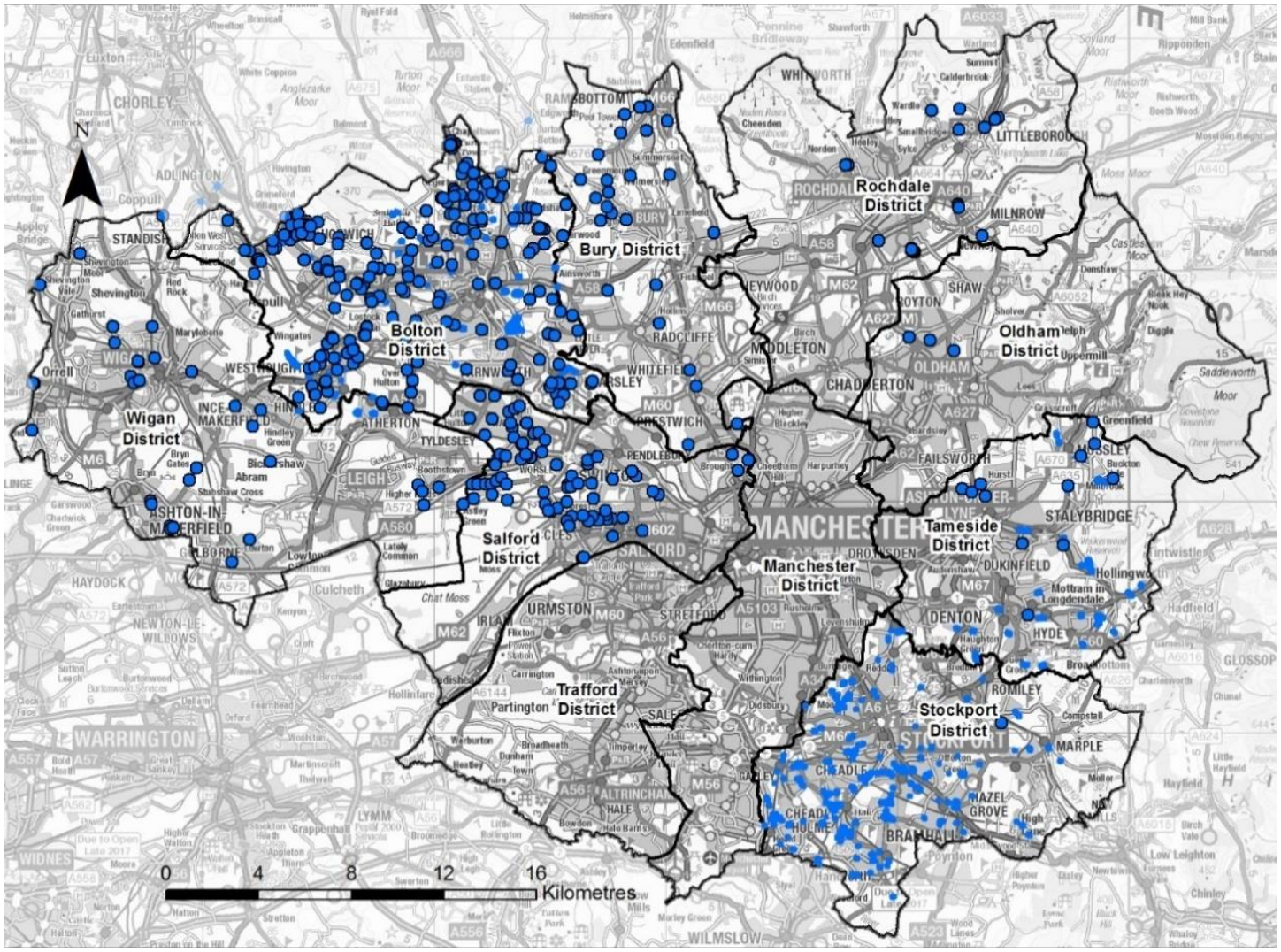
However, the provision of spatial datasets of historic flood events will depend on specific LLFA resources and priorities.

Each GM LLFA was requested to provide a copy of its historic flood incidents database for use in the evidence base for this SFRA.

Figure 6-7 shows the historic records provided.

Given that many of these incidents are at the property level and therefore considered as sensitive information, they have not been included on the detailed large scale SFRA Maps.

Figure 6-7: GM LLFA historic flood incidents



The scale and content of each LLFA's historic records is variable, as can be seen from Figure 6-7.

The absence of incidents in Manchester and Trafford and the low numbers in Oldham and Rochdale does not mean that flood incidents have not occurred, it just means that past incidents have not been recorded or are not available spatially and cannot therefore be mapped. It is also unknown as to how far back the records go relative to each council.

Each LLFA should ensure that its flood incident register is up to date and attempt to make the register available spatially.

Each LLFA's LFRMS also summarise historical flood events that have occurred across their areas.

6.7.1 Historic surface water flooding

UU provided information on historic incidents of flooding from the sewer network, due to hydraulic failure. Due to the sensitivity of the data being out in the public domain, UU were unable to provide the data at the exact locations of the incidents.

Incidents have therefore been aggregated into 100 m^2 grid squares and are shown at the GM level on Figure 6-8. The incident squares are also shown on the SFRA Maps. The dates of the incidents are unknown however by far the most incidents have occurred in the east of Foggbrook in Stockport.

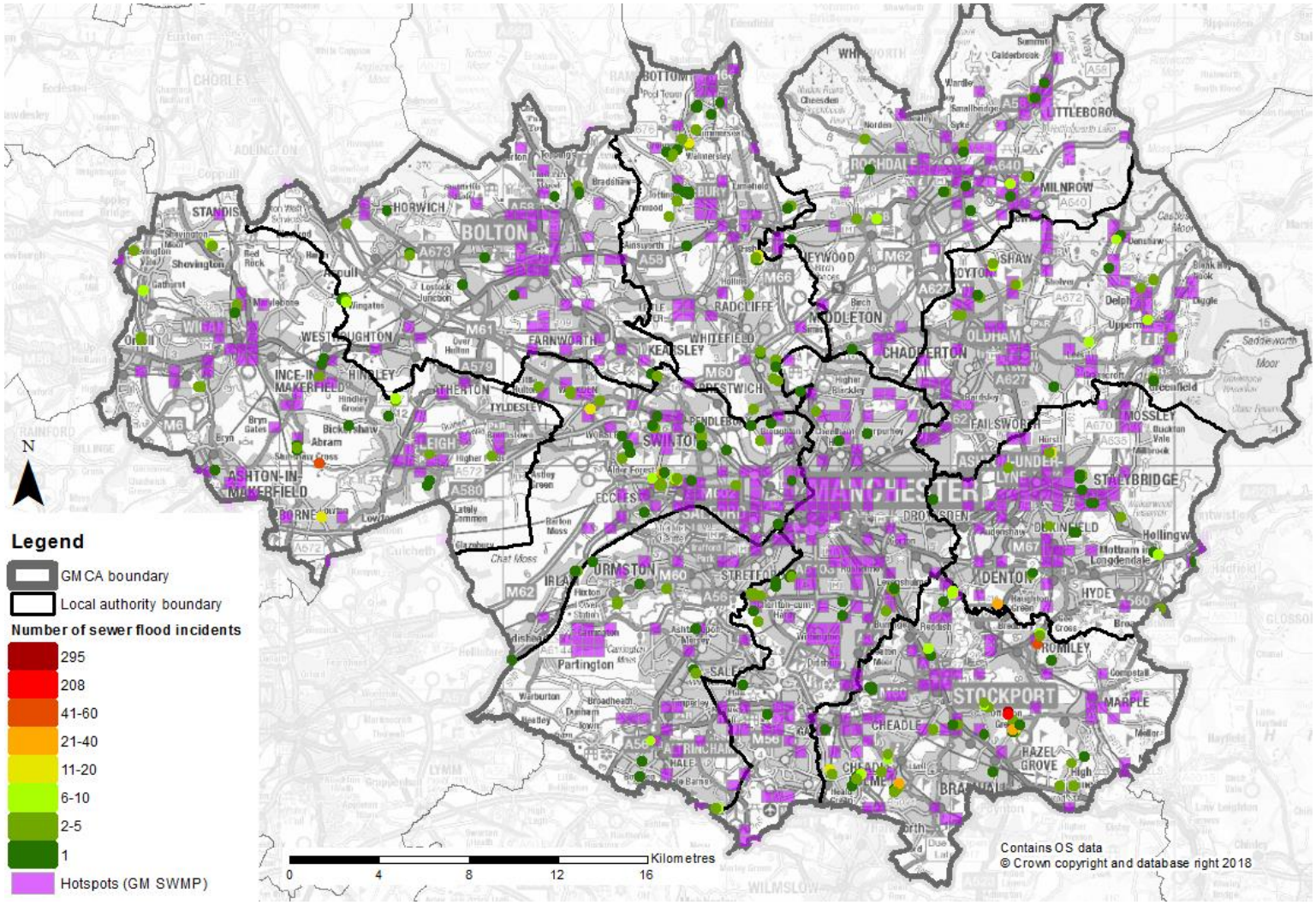
For those areas outside of the incident squares, this does not indicate that flooding has never occurred, only that there are no records of a flood having occurred.

Figure 6-8 also shows the Hotspots generated from the GM SWMP in 2013 (see Section 4.7.2.1), of which there are 580 identified, based on the spatial relationship between modelled flood hazard outputs and local critical and vulnerable receptors.

Manchester District has by far the most Hotspots of 105 whilst Bury has the lowest at 37. This is to be expected given the highly urbanised land use of Manchester compared to the more rural and undeveloped areas that exist in Bury, particularly in the uplands. Salford and Oldham have 63 and 60

respectively followed by Stockport, Tameside, Rochdale and Wigan with between 53 and 58 Hotspots identified. Bolton has 49 and Trafford 43.

Figure 6-8: UU historic sewer flooding incidents and GM SWMP Hotspots



6.7.2 EA Historic Flood Map / Recorded Flood Outlines

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 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 the flood events.

The difference between the two datasets is that the HFM only contains flood outlines that are 'considered and accepted' by the EA following adequate verification using certain criteria. For those areas not within a HFM or RFO outline, this does not mean these areas have never flooded, only that the EA does not have records of flooding in this area.

There are 74 historic flood outlines included within the HFM in GM. The most notable areas of HFM include a large area of Salford, covering Lower Broughton and Lower Kersal, where flooding has occurred from the River Irwell. Also, there are several HFM outlines within Wigan Town Centre at Newtown and Wallgate. Only Oldham, Tameside and Trafford authority areas do not have any areas of HFM within them.

There are 478 outlines within the RFO dataset with 404 of these not included with the HFM and therefore not considered and accepted by the EA. The most notable RFO areas, not within the HFM, include a large area in Manchester,

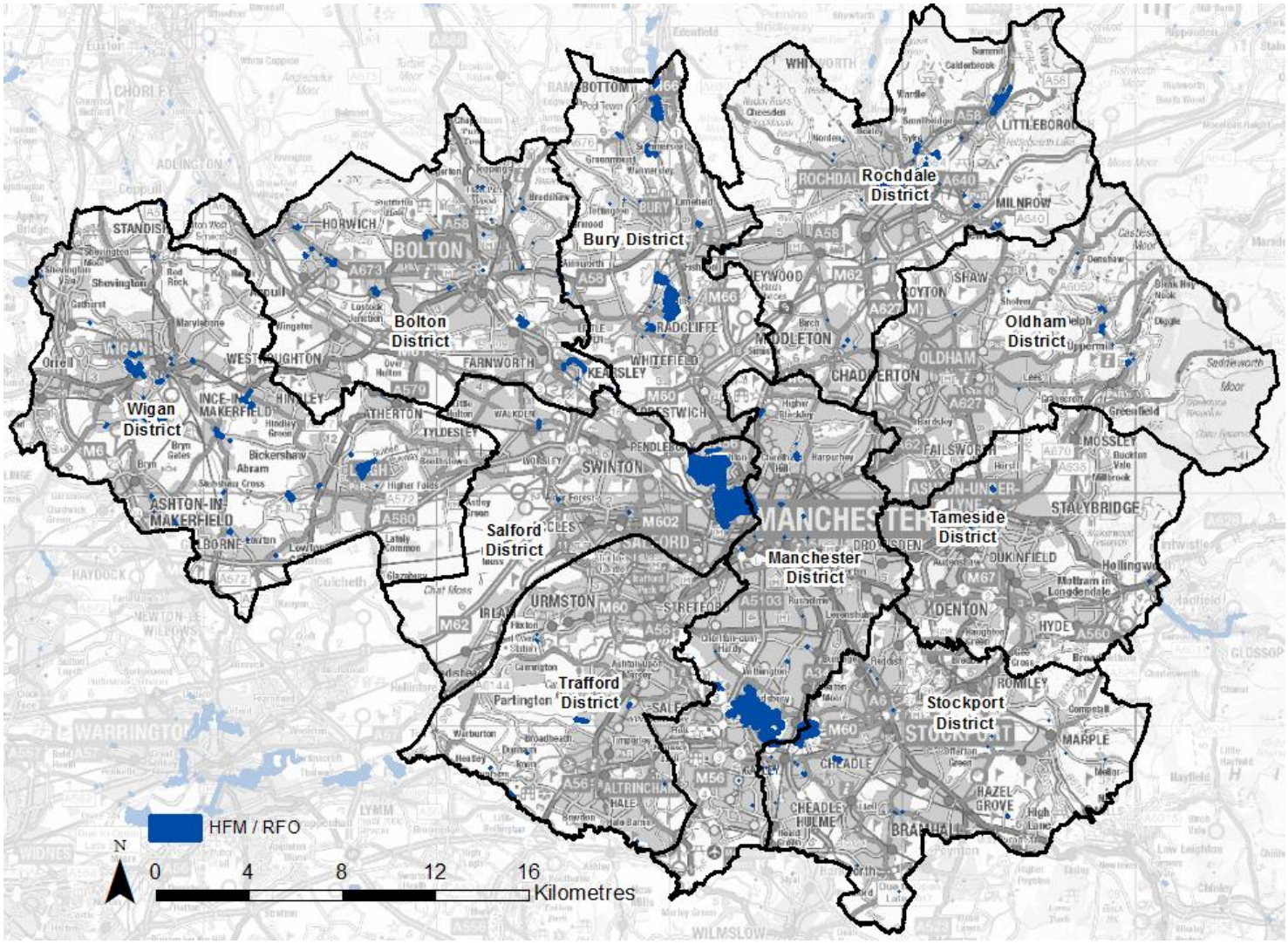
south of Didsbury and north of the M60 motorway. Much of this land is undeveloped natural floodplain of the River Mersey.

Also, in Bury around the areas of Redvales and Barlow Fold and also Ramsbottom, there are outlines relating to flooding from the River Irwell. Littleborough in Rochdale also has a large RFO area due to flooding from the River Roch and also surface water in December 2015.

In terms of flood source, there are 197 records of flooding from Main River, 15 from drainage failure, 13 from ordinary watercourse, 4 from sewers, 12 from other sources and 237 unknowns.

The HFM and RFO datasets are shown in detail on the large scale SFRA maps in Appendix A and are also shown in Figure 6-9 at the GM scale.

Figure 6-9: HFM and RFO outlines



On Boxing Day, 2015 Storm Eva led to one of the most widespread flooding events that affected communities in nine of the ten GM LAs (all but Trafford). The Greater Manchester Flood Investigation Report (FIR), as required by Section 19 of the FWMA, identifies the causes and impacts of the flooding and sets out recommendations of the future.

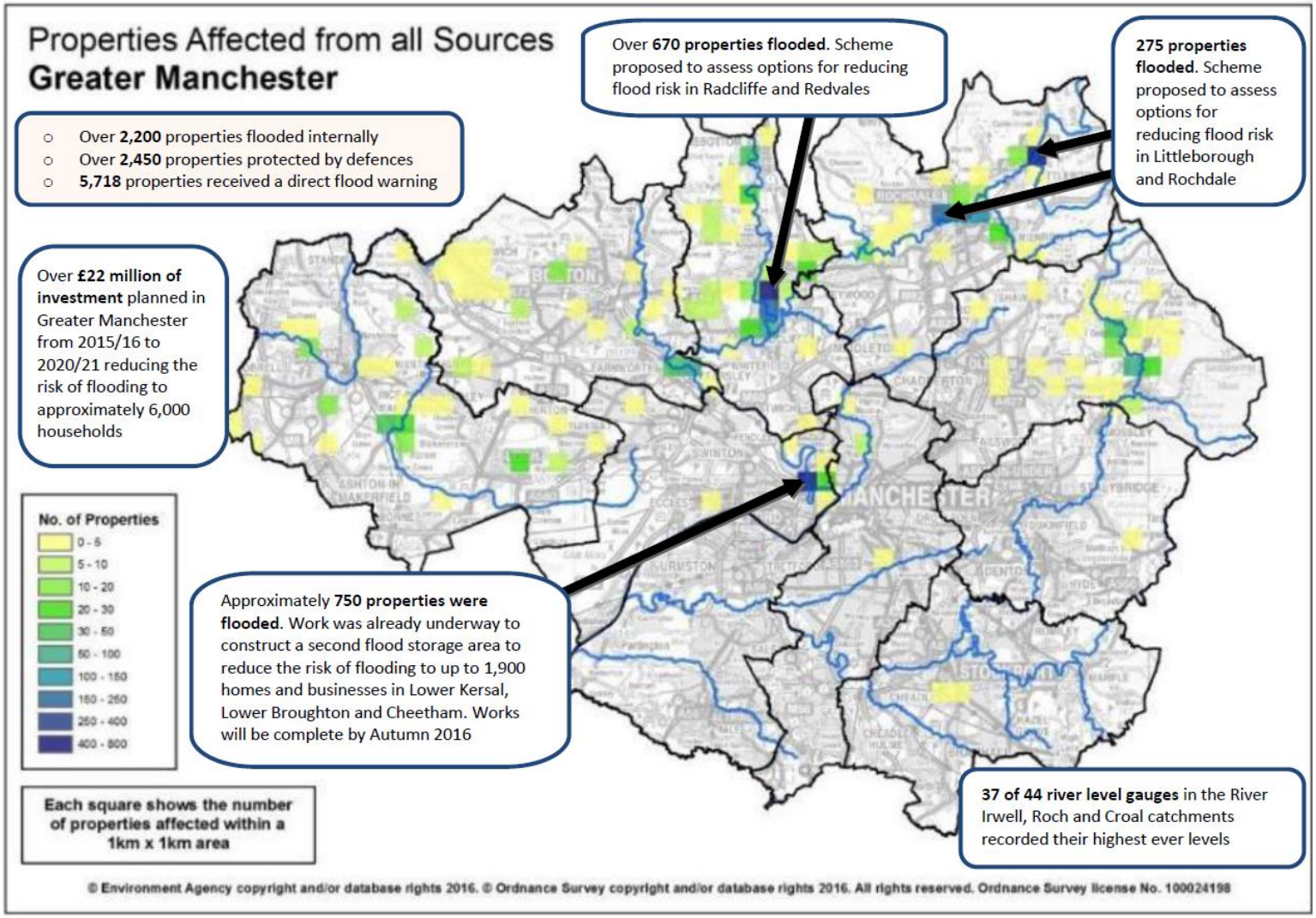
37 of 44 gauges in the River Irwell, Roch and Croal catchments recorded their highest ever levels. Heavy rainfall commenced on Christmas Day lasting 36 hours and falling on already saturated ground due to high rainfall in the preceding month.

Approximately 2,350 properties flooded internally with 80% of the flooding from main rivers. Around 2,450 properties were protected from flooding by raised defences along main rivers, culvert clearance and pumping station operation.

Surface water and ordinary watercourse flood alleviation also protected properties. Significant impacts resulted with the flooding of key infrastructure causing widespread travel disruption and over 31,200 properties initially left without power. The most seriously affected areas were Salford, Radcliffe / Redvales, Littleborough and Rochdale Town Centre.

Flood defence improvements have since been completed or are being progressed in these areas.

Figure 6-10: Geographical scale and extent of flooding across GM (from GM FIR)



The GM FIR provides detailed recommendations regarding flood warning, emergency responses, flood alleviation interventions and ways of working and identifies the responsible RMAs for each recommendation.

Continued cooperation and collaboration between GMCA, the ten LLFAs, the EA, UU and the MSC company are identified as crucial to minimise the chance of such an event recurring and manage the impacts if it should.

6.8 Flood Risk Management

The aim of this section of the SFRA is to summarise FRM assets and previous / proposed FRM schemes within GM. 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.

6.8.1 EA 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, beach, dunes);
- Flood source (fluvial, tidal, fluvial and tidal);
- Design standard (SoP);
- Asset length;
- Asset age;
- Asset location; and
- Asset condition. See Table 6-6 for condition assessment grades using the EA's Condition Assessment Manual[22] (CAM).

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

Table 6-6: EA flood defence condition assessment grades

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.

Regarding the EA's asset condition grades, asset repair is governed by the 'Target Condition' rather than the actual condition of the asset. If the actual condition is worse (higher score) than the target condition, work will be initiated to look at necessary repairs. In some cases, assets have a Target Condition of 2 meaning that a score of 3 will require attention. In other cases where assets have become redundant, the Target Condition could be 4 or sometimes 5.

In total, there are 530 manmade raised flood defences across GM, according to the EA's spatial flood defence dataset. This includes flood embankments and flood walls offering protection from fluvial flooding, the majority of which tend to be along the River Mersey in Manchester and Trafford authority areas.

A number of these defences have an actual condition grade, as per Table 6-6, of 5, meaning complete performance failure. It is likely to be the case that these assets have become redundant. If not, then these assets should be replaced to prevent future incidents of flooding.

The SFRA Maps indicate the actual condition grades of each defence asset. It is those with condition grades of 4 or 5 where assessment and future investment is required. Ownership information of these assets is unknown though the EA should have records of ownership and maintenance details.

6.8.2 LLFA assets

The LLFAs own and maintain a number of assets throughout their own authority areas which will include culverts, bridge structures, gullies, weirs and trash

screens. Most of these assets will 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 / landowner.

As part of its FWMA duties, the LLFA has a duty to maintain a register of structures or features, which are considered to have a significant effect on flood risk, including details on 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 LLFA to maintain any third-party features, only those for which the authority has responsibility as land/asset owner.

Each LLFA was requested to provide a spatial dataset of its flood risk management assets that are in the most critical condition and therefore in need of remedial works or replacement to maintain FRM performance.

Bolton Council provided a list of 11 assets that are in critical condition, mainly relating to culverts and trash screens.

Wigan Council provided a list of its top 20 culverts that are in critical condition.

The locations of these assets are shown on the SFRA Maps.

The other eight authorities did not provide a spatial dataset of critical assets. That is not to say these authorities do not have a list of critical assets, it may just be the case that they have not yet been mapped.

Each LLFA should carry out a strategic assessment of structures and features on its FRM Asset Registers to inform the capital programme and

prioritise maintenance works. Critical assets (i.e. culverts in poor condition) should be prioritised for designated works and funding for future FRM should be directed towards these assets.

6.8.3 Water company assets

The sewerage infrastructure of the urban areas of GM is likely to be based on Victorian sewers from which there is a risk of localised flooding associated with the existing drainage capacity and sewer system.

The drainage system may be under capacity and / or subject to blockages resulting in localised flooding of roads and / or property. UU is responsible for the management of the adopted sewerage system. This includes surface water and foul sewerage.

There may however be some privately owned surface water sewers 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.

6.8.4 Green Infrastructure assessment

Open space, or Green Infrastructure (GI), should be designed and managed as a multifunctional resource. It should be capable of delivering a wide range of environmental and quality of life benefits for local communities. It should be

provided as an integral part of all new development, alongside other infrastructure such as utilities and transport networks.

Open space can provide many social, economic and environmental benefits close to where people live and work including:

- Places for outdoor relaxation and play;
- Space and habitat for wildlife with access to nature for people;
- Environmental education;
- Local food production - in allotments, gardens and through agriculture;
- Improved health and well-being – lowering stress levels and providing opportunities for exercise;
- Climate change adaptation - for example flood alleviation and cooling urban heat islands.

The NPPF explains that open space can perform many functions, including flood risk mitigation, and that Local Plans should account for increased flood risk, resulting from climate change, through the planning of Green Infrastructure.

GI can have an important role to play in reducing the likelihood of flooding by providing space for flood storage, reducing runoff, and increasing infiltration, whilst also providing other benefits as stated above.

Alongside GI should be the implementation of SuDS, specifically within potential development sites, where possible. The suitability of GI and SuDS can be informed by this SFRA through utilisation of open space for water in the areas of greatest flood risk, which would be key to helping deliver sustainable development. Examples include:

- Restoration of the natural character of floodplains;
- Keeping and preserving of areas of existing natural floodplain;
- Introduction of new areas and enhancing existing areas of greenspace whilst incorporating sustainable drainage within new development; and
- Reduction of downstream flood risk.

Natural England recommend the use of the online tool Local Action ToolKit:

Local Action Toolkit

This tool can be applied to urbanised environments to identify how SuDS as well as GI can be most effectively applied in a constrained urban setting, whilst considering the benefits of biodiversity and natural capital.

Natural England advise that the GM councils utilise this tool when making specific decisions within their Local Plan areas.

The Town and Country Planning Association together with The Wildlife Trusts produced a guidance document for Green Infrastructure[23]. The guidance states that local plans should identify funding sources for GI and provision should be made for GI to be adequately funded as part of a development's core infrastructure.

For new developments, GI assets can be secured from a landowner's 'land value uplift' and as part of development agreements. LPAs may include capital for the purchase, design, planning and maintenance of GI within the Community Infrastructure Levy (CIL) programme.

6.8.5 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.

NFM and WwNP are used interchangeably in the UK though the term WwNP is mainly used throughout this report.

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.).

23 Planning for a Healthy Environment - Good Practice Guidance for Green Infrastructure and Biodiversity, Published by the Town and Country Planning Association and The Wildlife Trusts, July 2012

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.

Techniques and measures, that may be applicable to GM, include:

- Peatland and moorland restoration in upland catchments
- Re-meandering streams
- Targeted woodland planting
- Reconnection and restoration of functional floodplains
- Restoration of rivers and removal of redundant structures
- Installation or retainment of large woody material in river channels
- Improvements in management of soil and land use
- Implementation of rural and urban SuDS

Both the European Commission and UK Government are actively encouraging the implementation of WwNP measures within catchments and coastal areas. The idea is to assist in the delivery of the requirements of various EC Directives relating to broader environmental protection and national policies.

It is fully expected that the sustained interest in WwNP implementation across the UK will continue in the post-Brexit era as a fundamental component of the flood risk management tool kit.

GMCA actively promotes NFM and is proposing measures within the uplands of GM to manage fluvial water across the main river catchments, such as the Irwell (see Section 4.4.1). The EA is also exploring the use of upland reservoirs to store floodwater.

6.8.5.1 Evidence base for WwNP to reduce flood risk

The EA recently produced the WwNP evidence base that includes three interlinked projects:

- Evidence directory
- Mapping the potential for WwNP
- 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 that include WwNP measures to help understand:

- Their potential FCRM benefits and multiple benefits
- Any gaps in knowledge
- Where it has been done before and any lessons learnt
- Where in a catchment they might be most effective.

The evidence directory presents the evidence base, setting out the underpinning scientific evidence. Its purpose is to help FRM practitioners and other responsible bodies access information that explains what is known and what is not known about the effectiveness of the measures from a flood risk perspective.

There is also a guidance document that sits alongside the evidence directory and maps that can help make the case for implementing WwNP when developing business cases.

6.8.5.2 Mapping the potential for WwNP

JBA Consulting has been working with the EA and Lancaster Environment Centre (LEC) to update national maps of the Potential for Working with Natural Processes. LEC has developed a new spatial model of slowly permeable soils. This is used to identify areas where shrub or tree-planting could increase hydrological losses and slow the flow based on British Geological Survey (BGS) 1:50k maps. BGS has agreed to an open Government license for use of the maps.

The new national maps for England make use of different mapping datasets and highlight potential areas for tree-planting (for three different types of planting), runoff attenuation storage, gully blocking, and floodplain reconnection.

The maps are high level and can be used to signpost areas of potential. They do not take into account issues such as landownership and drainage infrastructure. They may however help start the conversation and give indicative estimates of, for example, additional distributed storage in upstream catchments.

Interactive mapping showing the potential for WwNP is available for all river basin districts, including the North West, via: Potential for Working with Natural Processes interactive map

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 all GIS platforms and interactive GeoPDF format, supported by a user guide and a detailed technical guide.

Table 6-7 is extracted from the technical report for mapping the potential for Working with Natural Processes, January 2018, and includes the technical detail on which the WnWP data is based.

Table 6-7: WwNP measures and data[24]

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.

24 Working with Natural Processes mapping technical report

This SFRA has screened this data against the potential development sites data, as mentioned in Section 1.3.1. The datasets included in the sites screening include the following:

- Floodplain Reconnection:
    - Floodplain Reconnection Potential - areas of low or very low probability based on the Risk of Flooding from Rivers and Sea dataset (Section 6.3.5), 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 (Runoff attenuation features are based on the premise that areas of high flow accumulation in the RoFSW) maps are areas where the runoff hydrograph may be influenced by temporary storage if designed correctly):
    - Runoff Attenuation Features 1% AEP
    - Runoff Attenuation Features 3.3% AEP
- Tree Planting:
    - Floodplain Woodland Potential and Riparian Woodland Potential - woodland provides enhanced floodplain roughness that can dissipate the energy and momentum of a flood wave if planted to obstruct significant flow pathways.

      Riparian and floodplain tree planting are likely to be most effective if close to the watercourse in the floodplain, which is taken to be the 0.1% AEP flood extent (Flood Zone 2), and within a buffer of 50 metres of smaller watercourses where there is no flood mapping available.

      There is a constraints dataset that includes existing woodland.
    - Wider Catchment Woodland Potential - slowly permeable soils have a higher probability of generating ‘infiltration-excess overland flow’ and ‘saturation overland flow’. These are best characterised by gleyed soils, so tree planting can open up the soil and lead to higher infiltration and reduction of overland flow production.

These datasets are included in the SFRA Maps in Appendix A and are also screened against the potential development sites to highlight any sites were the potential for WwNP should be investigated further as a means of flood mitigation (see Section 7.3.4 and in particular Appendix B).

6.8.5.3 Irwell Strategic NFM Targeting Mapping (2017)

Continuing the Rivers Trust work, discussed in Section 4.4.1, this project maps the changes that NFM (or WwNP) measures are predicted to have on surface water runoff, in terms of peak surface runoff reduction and timing of the peak runoff.

The Targeting Maps and accompanying User Guide are based on strategic modelling and should only form part of the picture for helping to show where and how we can work better with natural processes to slow and store flows.

It must be remembered that modelling the effects of NFM comes with inherent uncertainties, partly due to gaps in the evidence base.

One of the aims of the project was to identify WwNP intervention opportunities and assess the benefits in terms of flood risk regulation considering the whole Irwell catchment.

Strategic surface water flood risk modelling across the Irwell has been completed using the design rainfall events of 1 in 30 AEP and 1 in 100 AEP events. The difference in the runoff generation **with and without WwNP has been compared around the catchment.**

The scenarios modelled included:

- Runoff Attenuation Features (RAFs) - extra storage opportunities in areas predicted to collect surface runoff during flood events were modelled. Such opportunities include natural depressions and small channels between 100-5,000 m^2 which can be created through river improvement or bunds. These features tend to reduce peak runoff if they are designed carefully to fill at high flows and drain away between events;
- Tree-planting and roughening-up the landscape - woodland and scrubland creation in areas identified in the Woodlands for Water (WfW) opportunity mapping was modelled as additional enhanced surface roughness. This

has less impact on the volume of the runoff peak but can significantly delay the timing of the peak runoff in headwater catchments. Further downstream in the catchment, roughening up the landscape can both delay and reduce runoff peak as it desynchronises flows from headwater catchments; and

- Enhanced urban and rural losses - improved soil structure, resulting in enhanced soil moisture storage capacity, has been simulated for rural landcover designated as 'improved grassland' in the Land Cover Map 2007. In addition, for urban areas, it is assumed that green spaces are increased, and the overall landscape made more permeable. UU figures for impervious surfaces were used as a baseline and the percentage runoff was reduced from around 70% to 65%. This intervention reduces peak runoff but has less impact on the timing of peak flow. In urban areas the reduction in runoff of 5% for SuDS is a conservative estimate.

The maps should be used to identify where SuDS could make a significant contribution. Intensive delivery of SuDS could reduce runoff further.

The modelled interventions are shown on the SFRA Maps in Appendix A. They are also screened against the potential development sites to highlight any sites were the potential for WwNP should be investigated further as a means of flood mitigation (see Section 7.3.4).

6.8.5.4 Limitations

Users of the WwNP datasets should bear in mind that these datasets are high level and exist on a national scale. They can only provide an indication of whether an area may have potential for WwNP.

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, FRM measures should be selected from a series 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.

6.8.6 EA Flood Risk Management Activities and Flood and Coastal Erosion Risk Management Research and Development

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

- Maintaining and improving existing flood defences, structures and Main River channels.
- 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) where appropriate.
- Working with LPAs 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, i.e. through this SFRA.
- Operation of Floodline Warnings Direct and flood warning services for areas within designated Flood Warning Areas (FWA) or Flood Alert Areas (FAA). EA FWAs and FAAs are shown on the SFRA Maps in Appendix A and more information is provided in Section 8.2.
- Promoting awareness of flooding so that organisations, communities, and individuals are aware of the risk and are therefore sufficiently prepared in the event of flooding.
- Promoting resilience and resistance measures for existing properties that are currently at flood risk or may be at risk in the future because of climate change.

The Flood and Coastal Erosion Risk Management (FCERM) Research and Development programme is run by the EA and Defra. It aims to serve the needs of all flood and coastal operating authorities in England.

The programme provides the key evidence, information, tools, and techniques to:

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

Based on information publicly available from the EA, there are several completed, ongoing and proposed flood risk management work programmes applicable to GM.

Follow the link below for the latest news:

Environment Agency Flood and Coastal Erosion Risk Management works

There are 130 FRM projects planned for GM through the EA's Investment Programme from the period 2017/18 to 2025/26.

The locations of these projects can be seen on the SFRA Maps and further details on the projects is provided in the proposed SFRMF.

6.9 Taking climate change into account

Climate change will increase flood risk over the lifetime of a development and therefore must be accounted for when planning development. The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change.

GMCA and the GM local authorities should refer to this when preparing the GMSF and local plans respectively, when considering planning applications.

6.9.1 Planning for climate change (NPPF, 2019)

In relation to flood risk and climate change in the planning system, the 2019 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 157).

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.

Also, it is stated that

"*the sequential approach should be used in areas known to be at risk now or in the future from any form of flooding"* (para 158).

See Sections 7.2.2 and 7.3.3 for information on the screening of potential development sites against modelled climate change data, the results of which have been included in the sites assessment spreadsheets in Appendix B.

GMCA and the individual councils should use this information in the sequential testing of their sites.

6.9.2 EA climate change allowances

The EA revised the climate change allowances in February 2016 and further updated them in February 2017, for use in FRAs and SFRAs, and will use these

revised allowances when providing advice: Environment Agency climate change allowances

The revised climate change allowances are predictions of anticipated change for:

- Peak river flow by RBD;
- Peak rainfall intensity;
- Sea level rise; and
- Offshore wind speed and extreme wave height.

Deciding on which of the peak river flow allowances to use is based on the flood zone the development is within and the associated vulnerability classification (see Table 2 of the FRCC-PPG).

Climate change allowances for river flows are based on which River Basin District the river is located within. As discussed, GM is within the North West RBD.

Table 6-8: Recommended peak river flow allowances for the North West RBD

RBD	Allowance Category	Total Potential Change Anticipated for…		
		2020s (2015-2039)	2050s (2040-2069)	2080s (2070-2115)
North West	Upper end	+20%	+35%	+70%
	Higher central	+20%	+30%	+35%
	Central	+15%	+25%	+30%

The peak rainfall intensity allowance applies to the whole of England. SFRAs and FRAs should assess both the central and upper end allowances to gauge the range of impacts.

Table 6-9: Peak rainfall intensity allowance in small and urban catchments for England

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

The EA will also require consideration, if appropriate, of the 'high++ allowances' for peak river flows and mean sea level rise. This would usually be where a development is considered to be very sensitive to flood risk and with lifetimes beyond the end of the century. This could include infrastructure projects or developments that significantly change existing settlement patterns.

The high++ allowances can be found in the EA's *Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities*[25], which uses science from UKCP09. This guidance is based on Government's policy for climate change adaptation and is specifically intended for projects or strategies seeking Government Flood Defence Grant in Aid (FDGiA) funding.

However, RMAs in England may also find it useful in developing plans and making Flood and Coastal Erosion Risk Management (FCERM) investment decisions even if there is no intention of applying for central Government funding. This is important for any future large-scale infrastructure used to support the delivery of strategic sites such as flood defence schemes.

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

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

The UKCP09 high++ allowances for peak river flows in the North West RBD are presented in Table 6-10.

Table 6-10: UKCP09 High++ allowances for peak river flow

RBD	Total Potential Change Anticipated for…		
	2020s (2015-39)	2050s (2040-69	2080s (2070-2115
North West	+25%	+45%	+95%

Note: UKCP18 has been released and replaces UKCP09. EA advice on High++ allowances for peak river flows is to be produced in Spring 2019. See Section 6.9.3 below for more details on UKCP18.

Considering the impacts of climate change will have implications for both the type of development that is appropriate according to its vulnerability to flooding and design standards for any SuDS or mitigation schemes proposed.

For example, through very flat floodplains, using the +35 per cent from 2070 to 2115 allowance for peak river flows, could see an area currently within lower risk zones (Flood Zone 2), in future be re-classified as lying within a higher risk zone (Flood Zone 3a).

Therefore, residential development may not be appropriate without suitable flood mitigation measures or flood resilient or resistant houses.

In well-defined floodplains, the same climate change allowance could have significant impacts on flood depths influencing building type and design (e.g. finished floor levels).

6.9.3 UKCP18

UKCP18 climate change projections were published in November 2018 and replace the UKCP09 projections which have been in place for ten years.

The EA states that the 2016 allowances, referred to above, to be applied to peak river flows and peak rainfall intensities are still, at the time of writing, the best national representation of the effects of climate change on flood risk. However, high resolution mapping for the peak river flow allowances is due to be published

in Spring 2019 and high resolution (daily and sub daily) rainfall projections are due to be published later in 2019.

When the EA's climate change allowances are updated, the supporting guidance[26] will also be updated and will seek to address user feedback collated since February 2016 when the allowances were published.

Updates to climate change scenarios in flood risk models will follow on over time and will be made available for planners (for SFRAs) and developers (for site-specific FRAs) once available.

Refer to Section 7.2.2 for more information regarding climate change in GM and what it could mean for future development aspirations.

26 Environment Agency climate change allowances

7 Development and flood risk

7.1 Introduction

This section of the SFRA provides guidance on the Sequential Approach and on the application of the Sequential Test and the Exception Test.

The information and guidance provided in this chapter is also supported by the SFRA Maps in Appendix A, the Development Site Assessment spreadsheets in Appendix B and the sites summary reports in Appendix C.

Together, they can be used by GMCA and the individual councils to inform the GMSF and local plans and provide the basis from which to apply the Sequential Approach in the development allocation and development management process.

7.2 Site screening process

To inform the sequential approach to the allocation of development through the GMSF and local plans, this review entails a high-level GIS screening exercise. The screening involves overlaying the potential development sites against flood risk data.

The main output of this process is the production of a Development Site Assessment spreadsheet for each GM local authority. These spreadsheets can be viewed in Appendix B.

Each spreadsheet contains a column of strategic recommendations applied to each potential development site. The strategic recommendations are based on Tables 1 to 3 of the FRCC-PPG: Flood Zone and flood risk tables

- Table 1 refers to the EA flood zones, as presented previously in this report in Table 3-1;
- Table 2 refers to the vulnerability of different types and uses of development; and
- Table 3 includes a matrix of tables 1 and 2 presenting flood risk vulnerability and flood zone compatibility.

Table 7-1 of this report provides the definitions of each strategic recommendation. Refer to the individual authority sites assessment summary reports in Appendix C.

Table 7-1: Strategic recommendations

Strategic Recommendation	Definition
A	Consider withdrawal if development cannot take place outside of Flood Zone 3b
B	Exception Test required if site passes Sequential Test. For development to proceed, the site must be subject to and must pass the Exception Test
C	Consider site layout and design around the identified flood risk. It may be possible to deal with the flood risk through careful design and layout planning at the start of the site design phase
D	FRA required. Flood risk to site is low however an FRA is required to show risk can be mitigated
E	Site permitted on flood risk grounds. Flood risk to the site is assessed as very low and the site area is less than one hectare

7.2.1 Fluvial flood risk screening

Flood Zones 1, 2 and 3a are sourced from the EA's Flood Map for Planning (Rivers and Sea). Flood Zone 3b (functional floodplain) was updated as part of this SFRA, as discussed in Section 6.3.4 and in the technical notes in Appendix D. Each of these flood outlines were screened against the potential development sites provided by each LPA.

7.2.2 Fluvial climate change screening

Following the release of the revised EA climate change allowances in February 2016 (see Section 6.9.2), the EA was commissioned by GMCA to go about modelling these allowances for critical main rivers across GM. 66 of these watercourses are in GM and are listed in Appendix E.

The climate change modelling involved the modelling of two scenarios, namely,

- the current 1 in 100 AEP flood event +35% on the peak flow and
- +70% on the peak flow,

as per the allowances shown in Table 6-8 for the higher central and the upper end allowance categories.

For this SFRA, the modelled 1 in 100 AEP event +70% flood outlines have been screened against the sites, where they are available.

The +70% allowance is the upper end limit expected to occur in 100 years' time and is advised when assessing more vulnerable development, such as residential. Residential development is considered to have a lifetime of 100 years.

As with the present-day fluvial flood outlines, the climate change outlines were screened against the potential development sites.

A broad assessment of climate change risk to sites has been carried out whereby any site within 100 metres of a modelled watercourse was screened against the climate change flood outlines. This provides a rough estimate of sites that are in the vicinity of climate change modelled watercourses but are shown to be at no additional risk from climate change. The results of this assessment are shown in the Site Assessment spreadsheets (Appendix B) and in Section 7.3.3.

Figure 7-1 provides a schematic of the main rivers in GM that have been modelled for climate change (coloured blue), at the time of writing, and have therefore been made available to assess climate change in this SFRA.

The EA is to continue to model climate change for the remaining watercourses (coloured red) though these outputs have not been completed in time for this SFRA.

Figure 7-1: Main River where climate change has / has not been modelled prior to this SFRA

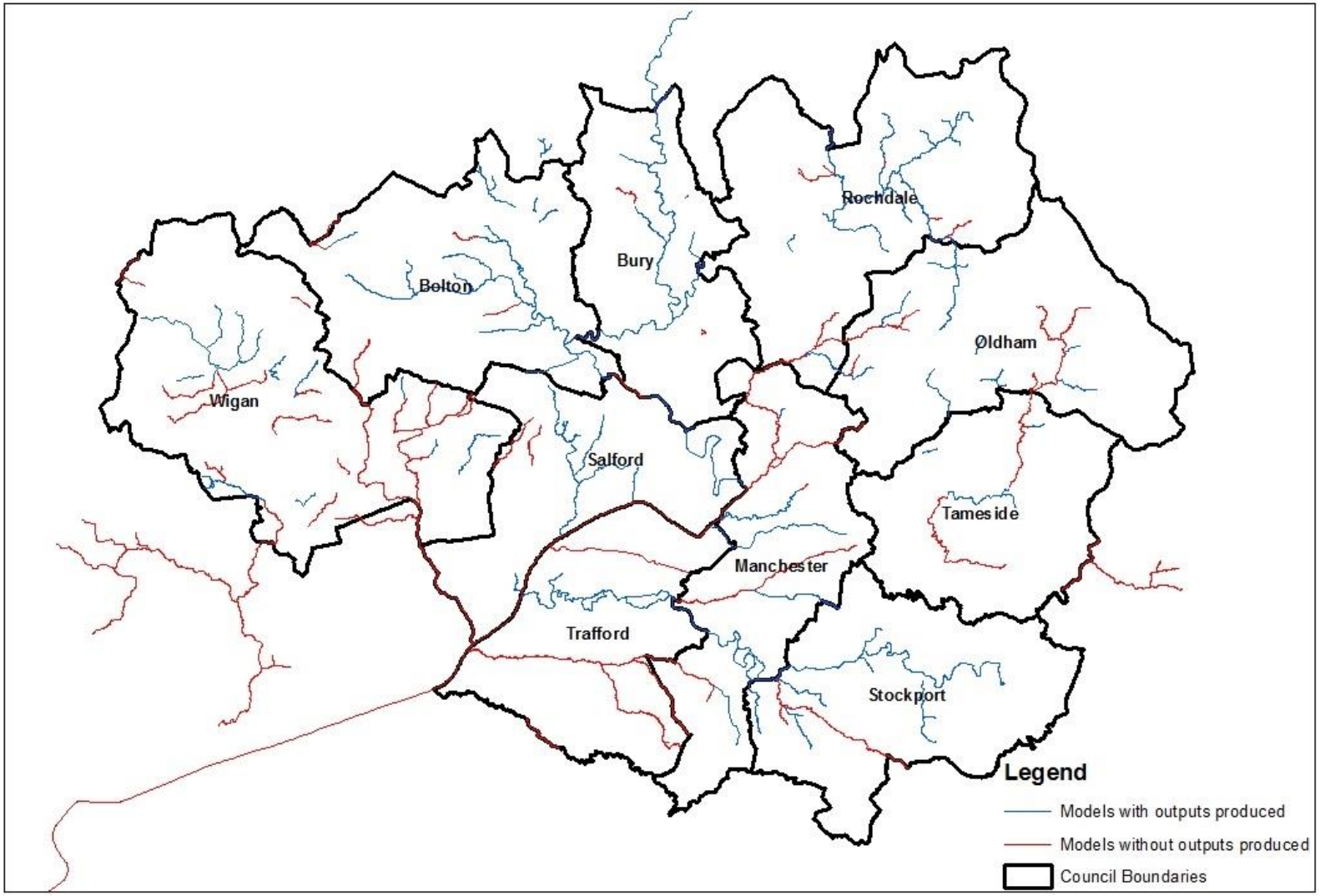


Table 7-2 lists the most notable watercourses that are still to be modelled for climate change, at the time of writing. Parts of these watercourses listed in Table 7-2 may have been modelled i.e. upstream section of Baguley Brook has been modelled for climate change yet the downstream section has not.

Wigan, at the time of writing, has the largest number of watercourses not modelled for climate change.

Table 7-2: Major watercourses not modelled for climate change

Watercourse	Authority
Manchester Ship Canal	Trafford; Salford; Manchester
Sinderland Brook	Trafford
Lady Brook	Stockport
Timperley Brook	Trafford
Baguley Brook	Manchester; Trafford
River Tame	Tameside; Oldham
Chorlton Brook	Manchester
Gore Brook	Manchester
River Irk	Manchester; Rochdale
Whit Brook	Manchester
Glaze Brook	Salford; Wigan
Westleigh Brook	Wigan
Carr Brook	Wigan
Shakerley Brook	Wigan
Smithy Brook	Wigan
Ince Brook	Wigan
Pennington Brook	Wigan; Bolton

Watercourse	Authority
Diggle Brook	Oldham
River Etherow	Stockport
Moston Brook	Manchester

Where modelled climate change outlines are not available, a precautionary approach should be considered. It is often the case that modelled 1 in 1000 year AEP event outlines are similar to modelled climate change scenarios for the 1 in 100 year AEP event.

Therefore, Flood Zones 2 and 3 of the EA's Flood Map for Planning have been used as a climate change proxy to provide an indication of risk to sites in the future.

For this SFRA therefore, the assumption should be that the current day Flood Zone 2 will become Flood Zone 3a in 100 years' time and the current functional floodplain could become Flood Zone 3a.

Predicting future expansion of the functional floodplain is however more difficult as the functional floodplain extent is based on a number of different criteria, as discussed in Section 6.3.4 and Appendix D.

This approach to climate change is precautionary though is the most pragmatic methodology available. This approach is also consistent with other SFRAs and professional modelling experience. As such, for any sites within Flood Zone 2, the possibility of these sites being within Flood Zone 3a within 100 years' time should be considered.

7.2.3 Surface water flood risk screening

Surface water risk to sites is assessed by way of the EA's RoFSW flood zones, namely:

- the high risk 1 in 30 AEP zone;
- the medium risk 1 in 100 AEP zone; and
- the low risk 1 in 1000 AEP zone.

Surface water flood risk should be afforded the equivalent level of importance as fluvial risk in terms of decision making for new development. However, as the Level 1 SFRA uses the high level national RoFSW to assess surface water risk, firm decisions on whether development can proceed or not cannot be made using this dataset.

For this SFRA it is suggested that for those sites with significant coverage of the 1 in 100 AEP surface water flood zone, detailed surface water modelling should be carried out to determine development viability.

This may be carried out through site-specific FRAs, Level 2 SFRAs or drainage strategies for large sites or clusters of sites.

7.3 Summary of sites screening process outcomes

Following the flood risk screening of the potential development sites carried out for each GM authority, Table 7-3 to Table 7-5 show the percentage of sites, by category, for each GM authority within flood zones 3b and 3a and also the high and medium risk surface water flood zones.

It may be the case that these sites can still be developed as, for some sites, there may only be nominal areas at risk which can be dealt with through mitigation or through amendment of site boundaries.

The strategic recommendations take this into account i.e. where a small proportion of a site is within the functional floodplain, it may be that consideration of site layout and design around the flood risk may mean the development can avoid the risk areas and therefore fall under Strategic Recommendation C as opposed to Strategic Recommendation A (see Table 7-1).

7.3.1 Flood zones

Table 7-3: Summary of GMSF allocation sites (2019) at existing risk across GM

Authority	Percentage of sites at risk… Flood Zone 3b (%)	Flood Zone 3a (%)*	High risk surface water (%)	Medium risk surface water (%)**
Bolton	N/A	N/A	N/A	N/A
Bury+	50	0	100	0
Manchester	33	0	67	33
Oldham^	35	0	94	0
Rochdale^+	54	0	100	0
Salford	25	0	100	0
Stockport	25	0	100	0
Tameside	0	0	100	0
Trafford	100	0	100	0
Wigan	60	20	100	0
GM	**38**	**2**	**92**	**2**

*No part of site within Flood Zone 3b

**No part of site within in the high risk outline

^Two sites overlap between Oldham and Rochdale

+ Two sites overlap between Rochdale and Bury

Table 7-3 suggests that there is a considerable number of allocations at high risk of flooding. These figures do not take account of the proportion of each site at risk. This is accounted for in Table 7-6 through the strategic recommendations.

Many of the allocations are large strategic sites therefore the total area at high risk is in most cases nominal, reflected in the fact that only two allocations are recommended for withdrawal if Flood Zone 3b cannot be avoided (Strategic Recommendation A).

Table 7-4: Summary of baseline land supply sites (2018) at existing risk across GM

Authority	Percentage of sites at risk… Flood Zone 3b (%)	Flood Zone 3a (%)*	High risk surface water (%)	Medium risk surface water (%)**
Bolton	4	3	20	13
Bury	4	4	33	12
Manchester	6	2	17	14
Oldham	5	1	29	14
Rochdale	13	2	35	13
Salford	7	6	23	16
Stockport	4	1	14	13
Tameside	8	4	22	15
Trafford	7	1	13	15
Wigan	6	5	30	12
GM	**6**	**3**	**23**	**14**

*No part of site within Flood Zone 3b

**No part of site within in the high risk outline

Table 7-4 shows that Rochdale has the highest proportion of baseline land supply sites within the functional floodplain, followed by Tameside.

Nearly a quarter of all baseline land supply sites across GM are at high risk from surface water (within the 3% AEP event outline). Again, these figures do not reflect the actual risk at the sites. The strategic recommendations account for this in Table 7-7.

Table 7-5: Summary of call for sites submissions (2018) at existing risk across GM

	Percentage of sites at risk…			
Authority	Flood Zone 3b (%)	Flood Zone 3a (%)*	High risk surface water (%)	Medium risk surface water (%)**
Bolton	13	2	64	6
Bury	15	4	82	5
Manchester	27	6	13	2
Oldham	24	3	71	7
Rochdale	35	3	96	0
Salford	33	11	74	11
Stockport	15	2	61	12
Tameside	16	0	71	10
Trafford	38	3	81	10
Wigan	22	5	92	2
GM	**21**	**3**	**73**	**7**

*No part of site within Flood Zone 3b

**No part of site within in the high risk outline

7.3.2 Strategic recommendations

Table 7-6 Table 7-8 list the number of strategic recommendations in place for each site, per site category, for each GM authority.

Table 7-6: Summary of strategic recommendations for GM allocations (2019)

	Number of strategic recommendations applied				
Authority	**A**	**B**	**C**	**D**	**E**
Bolton	0	0	1	2	0
Bury*	0	0	3	3	0
Manchester	0	0	1	2	0
Oldham^	0	2	5	10	0
Rochdale^*	1	1	5	6	0
Salford	1	0	0	3	0
Stockport	0	0	2	6	0
Tameside	0	0	1	3	0
Trafford	0	0	2	0	0
Wigan	0	0	4	1	0
GM	**2**	**3**	**24**	**36**	**0**

^Two sites overlap between Oldham and Rochdale

*Two sites overlap between Rochdale and Bury

Only two allocations are recommended for withdrawal based on the proportion of the site areas being within the functional floodplain. These allocations are in Rochdale and Salford.

Three allocations will have to be subject to and pass the Exception Test if the site boundaries cannot be altered to remove the high risk areas. Two of these sites are in Oldham and one is in Rochdale.

These five sites should be further investigated by the LPA and LLFA to ascertain developability.

24 allocated sites require careful consideration of site design and layout with regards to avoiding or accommodating the flood risk. This should take place as

part of a detailed site-specific FRA and drainage strategy used to inform the design and layout of the proposed site.

Table 7-7: Summary of strategic recommendations to baseline land supply (2018) sites

	Number of strategic recommendations applied				
Authority	**A**	**B**	**C**	**D**	**E**
Bolton	2	9	44	215	131
Bury	3	5	29	84	83
Manchester	3	9	53	281	272
Oldham	1	4	62	225	154
Rochdale	7	18	43	141	110
Salford	0	17	36	156	93
Stockport	2	5	31	197	176
Tameside	3	7	29	134	81
Trafford	1	4	23	211	105
Wigan	5	13	50	196	156
GM	**27**	**91**	**400**	**1840**	**1361**

The majority of the baseline land supply sites, in Table 7-7, will require site-specific FRAs as a minimum (Strategic Recommendation D).

Many sites are also at very low risk and may not require any further assessment of flood risk (Strategic Recommendation E), though this is at the discretion of the LPA.

27 land supply sites are recommended for withdrawal if the functional floodplain cannot be avoided, the majority being in Rochdale followed by Wigan. No land supply sites in Salford are recommended for withdrawal.

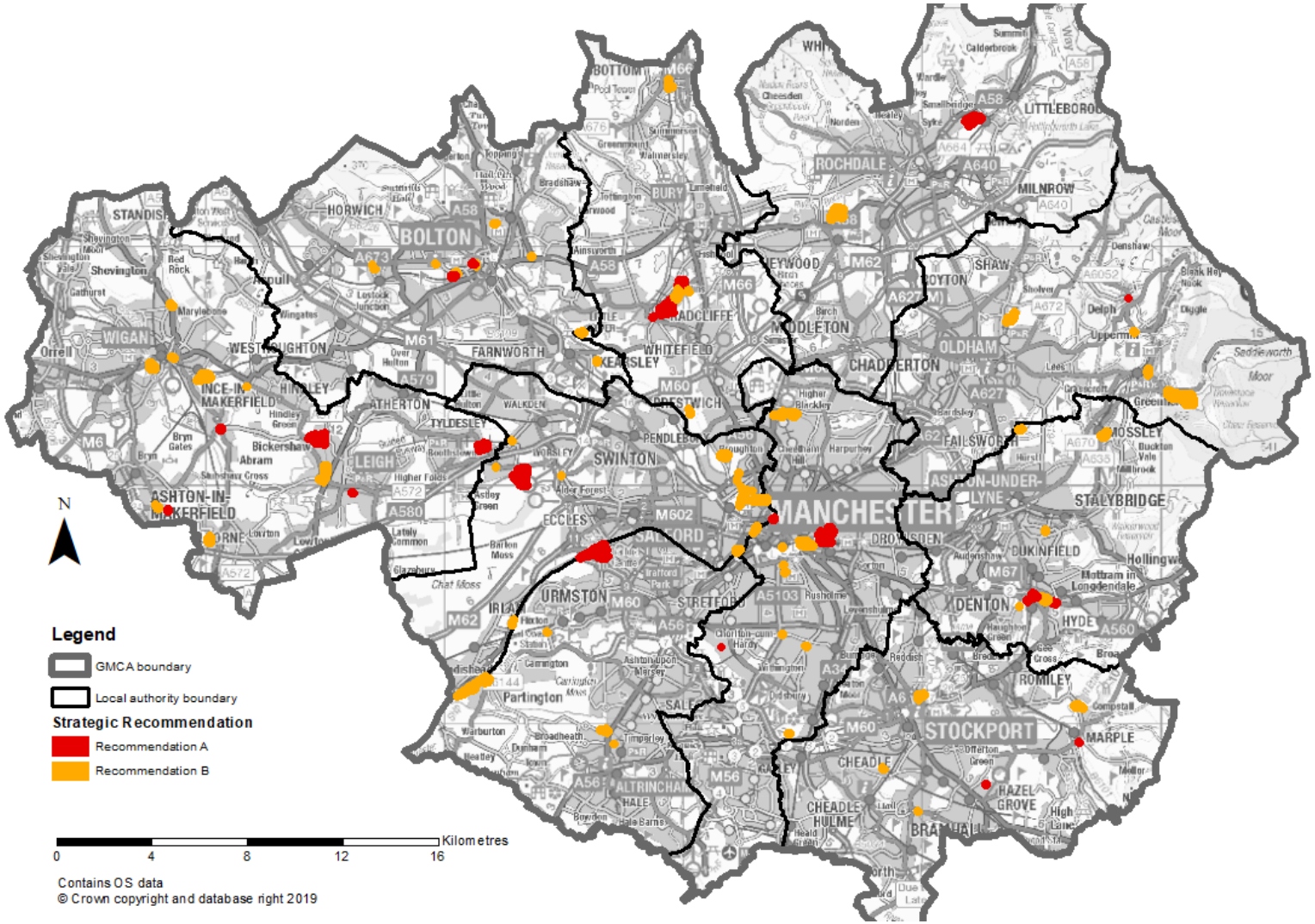
91 sites will require the undertaking and passing of the Exception Test if development is to be permitted. Most of these sites are in Rochdale, Salford and Wigan.

Table 7-8: Summary of strategic recommendations for call for sites (2018) sites

	Number of strategic recommendations applied				
Authority	**A**	**B**	**C**	**D**	**E**
Bolton	2	1	32	90	4
Bury	4	1	32	92	2
Manchester	2	2	13	24	11
Oldham	1	8	45	83	11
Rochdale	11	4	38	79	4
Salford	1	4	18	30	1
Stockport	6	3	53	208	27
Tameside	4	1	22	82	5
Trafford	6	2	21	41	2
Wigan	10	2	32	83	4
GM	**47**	**28**	**306**	**812**	**71**

Figure 7-2 presents a GM scale map of the GMSF allocations (2019) and the baseline land supply sites (2018) that are at the greatest risk and therefore fall under Strategic Recommendation A or B.

Figure 7-2: Allocations and land supply sites with strategic recommendations A and B



Many of the GMSF allocations are considerably large strategic sites which, when developed, may have a significant impact on flood risk across GM. Such sites will require their own drainage strategies for post development with a view to containing water on-site and where possible reducing risk off-site.

Some of the largest allocations are listed in Table 7-9.

Table 7-9: Large GMSF allocations that will influence flood risk in GM

Site	Authority	Area (ha)	Comments
New Carrington	Trafford	1,138	Very large strategic site; adjacent to MSC and River Mersey; upstream of Warrington Town Centre
Timperley Wedge	Trafford	225	Timperley Brook runs through; upstream of Hale and Altrincham
Elton Reservoir	Bury	252	Several watercourses; Manchester, Bolton and Bury Canal runs through the site; upstream of Radcliffe
Land at Jct 21, M62	Oldham	279	Upstream of Shaw, Royton and Chadderton
Godley Green Garden Village	Tameside	124	East of Hyde; a number of drains / ponds on-site
Land west of A627(M)	Oldham / Rochdale	200	East of Middleton and the Rochdale Canal; waterbodies on-site
Northern Gateway	Bury / Rochdale	858	East of Simister Island on M62 and M60; south of Whittle Brook; waterbodies on-site
Port Salford Extension	Salford	109	West of Eccles and Urmston; several drains on-site
West of Wingates / M61 Junction 6	Bolton	184	West of Westhoughton; rural surrounding; waterbodies on-site

Site	Authority	Area (ha)	Comments
Woodford Aerodrome	Stockport	120	Rural location south-west of Poynton; Red Brook and River Dean run along boundary

7.3.3 Climate change screening

As discussed in Section 6.9.2, considering the impacts of climate change will have implications for both the type of development that is appropriate according to its vulnerability to flooding and design standards for any SuDS or mitigation schemes proposed.

This section summarises the outcomes of the climate change screening discussed in Section 7.2.2 and recorded in the Site Assessment spreadsheets in Appendix B.

Table 7-10 to Table 7-12 summarise the sites potentially at increased risk in the future from climate change.

Table 7-10: GMSF allocations at possible risk from climate change

Authority	Number of sites… within 100m of a watercourse modelled for climate change	at no increased risk	at increased risk
Bolton	0	N/A	N/A
Bury	2	1	1
Manchester	0	N/A	N/A
Oldham	6	0	6
Rochdale	4	0	3
Salford	1	1	0
Stockport	1	1	0
Tameside	0	N/A	N/A
Trafford	0	N/A	N/A
Wigan	2	1	1
GM	**16**	**4**	**11**

Table 7-11: Baseline land supply sites at possible risk from climate change

Authority	Number of sites… within 100m of a watercourse modelled for climate change	at no increased risk	at increased risk
Bolton	77	44	33
Bury	40	21	19
Manchester	25	15	10
Oldham	34	21	13
Rochdale	68	37	31
Salford	62	22	40
Stockport	22	14	8
Tameside	19	9	10
Trafford	2	1	1
Wigan	72	41	31
GM	**421**	**225**	**196**

Table 7-12: Call for sites exercise sites at possible risk from climate change

Authority	Number of sites… within 100m of a watercourse modelled for climate change	at no increased risk	at increased risk
Bolton	11	5	6
Bury	22	9	13
Manchester	1	0	1
Oldham	30	4	26
Rochdale	25	2	23
Salford	23	8	15
Stockport	35	17	18
Tameside	1	1	0
Trafford	4	3	1
Wigan	9	1	8
GM	**160**	**63**	**97**

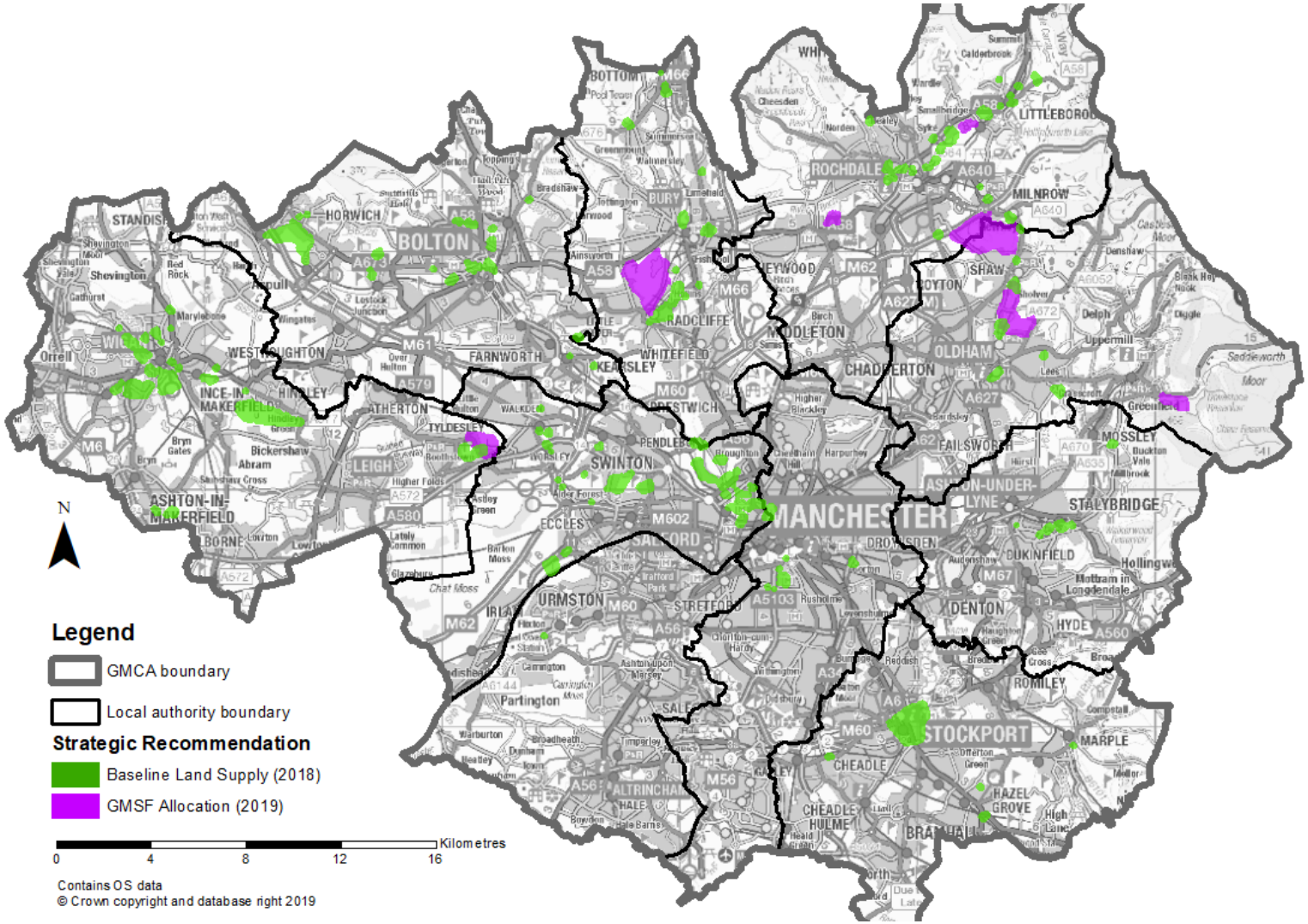
As only around 10% of GMSF allocations and baseline sites are near watercourses modelled for climate change, there is a heavy reliance on the use of Flood Zone 2 as a proxy for Flood Zone 3 in the longer term.

47% of allocations and baseline sites together (near modelled watercourses) are unlikely to be subject to increased risk whilst 53% are identified as having some increased risk. However, these only represent a small proportion of sites, so it is not possible to be conclusive.

All sites that have been identified as requiring an FRA through this SFRA should consider climate change as part of the FRA process. The sites identified as being at additional risk from climate change (see Site Assessment spreadsheets in Appendix B for specific sites) should also be subject to further investigation for the effects of climate change at the FRA stage.

Figure 7-3 presents a GM scale map of the potential development sites at further risk from climate change, based on watercourses modelled for climate change.

Figure 7-3: Sites at further risk from climate change



7.3.4 WwNP and Irwell Strategic NFM screening

The EA's WwNP datasets, discussed in Section 6.8.5.2, and the Irwell catchment NFM work (Section 6.8.5.3) are screened against the sites to provide a high level indication of those sites that may be appropriate to leave undeveloped and use for flood alleviation.

Much more detailed investigation is required before making decisions on sites that may have potential for WwNP.

Using the Development Sites Assessment spreadsheets in Appendix B, GMCA and each council are able to filter the sites that have large enough areas within the WwNP datasets and that are large enough in total area to be able to provide effective flood mitigation.

These filtered sites could then be assessed further through more detailed site-specific investigations on whether it would be possible in reality to use these sites for flood alleviation. Also, to check whether there would be any real benefits to surrounding areas and areas downstream.

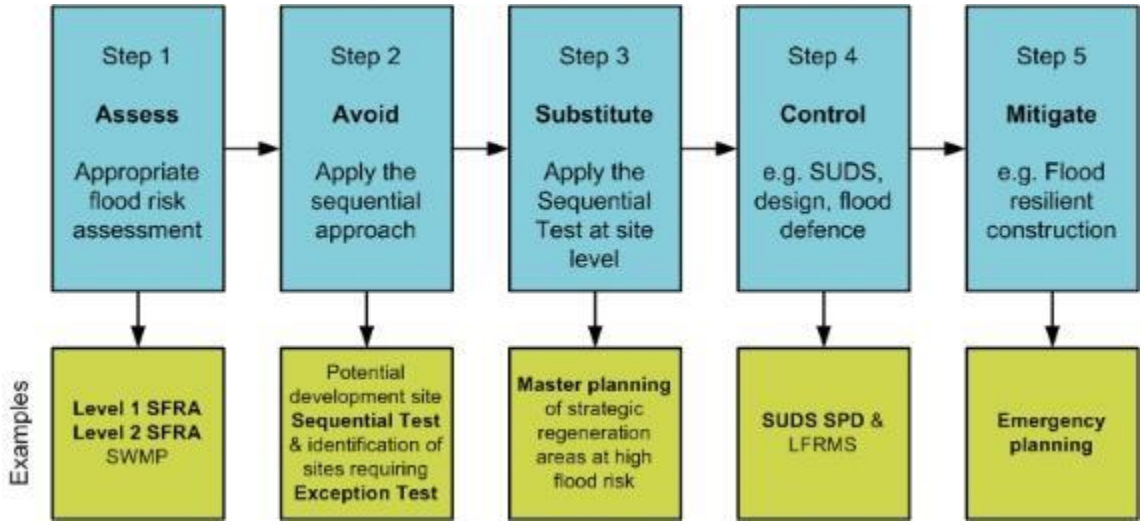
7.4 The Sequential Approach

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

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

Figure 7-4 illustrates the FRM hierarchy with an example of how these may translate into each authorities' management decisions and actions.

Figure 7-4: Flood Risk Management hierarchy



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

Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in higher risk Flood Zone 3, be considered. This should consider the flood risk vulnerability of land uses and the likelihood of meeting the requirements of the Exception Test, if required.

There are two different aims in carrying out the Sequential Approach depending on what stage of the planning system is being carried out i.e. LPAs allocating land in local plans (or in the case of GMCA, the GMSF) or determining planning applications for development. This SFRA does not remove the need for a site-specific FRA at a development management stage.

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

7.5 Sequential and Exception Test for the GMSF and local plans

As required by the NPPF, GMCA should seek to avoid inappropriate development in areas at risk of flooding. This should be done by:

- directing development away from areas at highest risk,
- ensuring that all development does not increase risk, and
- where possible can help reduce risk from flooding to existing communities and development.

At a strategic level, this should be carried out through the GMSF and the individual council's local plans. This should be done broadly by:

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

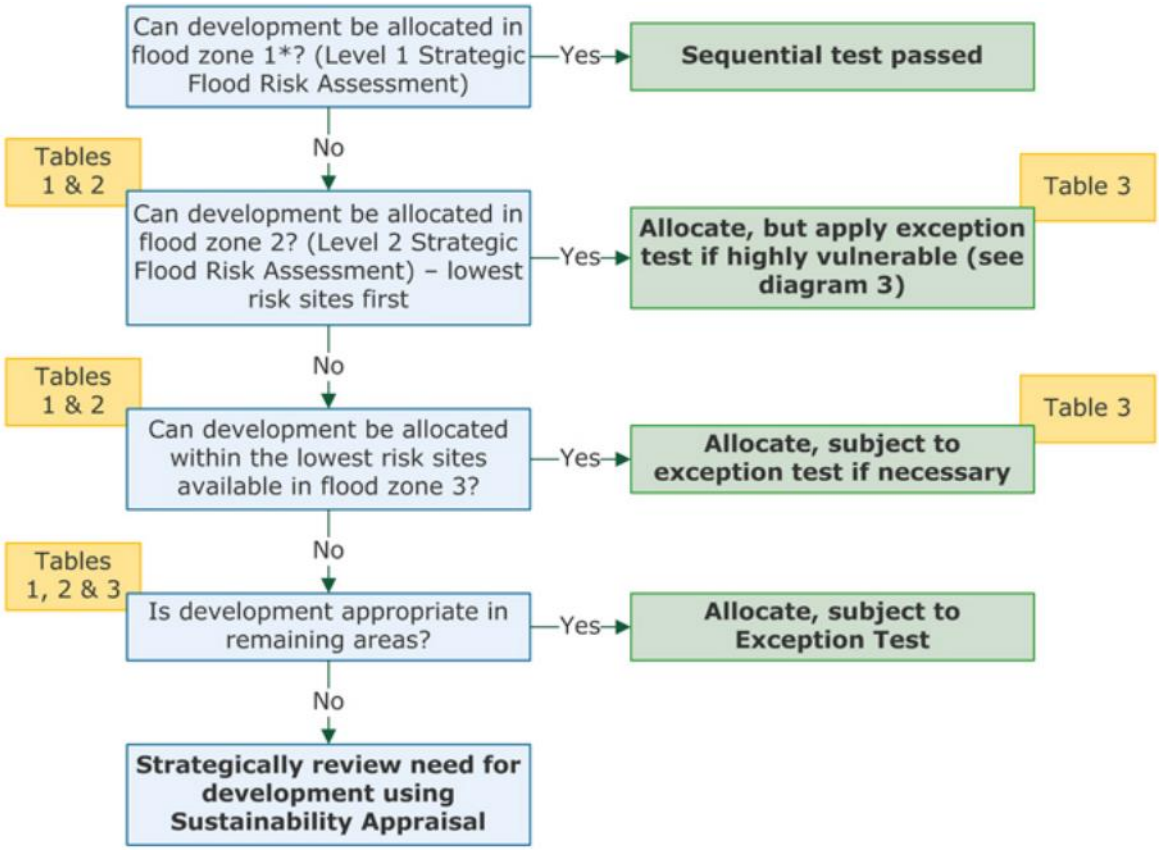
Figure 7-5 illustrates the Sequential and Exception Tests as a process flow diagram. It uses the information contained in this SFRA to assess potential development sites against the EA's Flood Map for Planning flood zones and development vulnerability compatibilities.

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

This can be done using the Development Site Assessment spreadsheets in Appendix B for each LPA. Each LPA has its own spreadsheet.

This spreadsheet will help show that each LPA has applied the Sequential Test, through this SFRA, and thus considered development viability options for each potential development site.

Figure 7-5: Local Plan sequential approach to site allocation[27]



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

The approach shown in Figure 7-5 provides an open demonstration of the Sequential Test being applied in line with the NPPF and the FRCC-PPG.

The EA works with local authorities to agree locally specific approaches to the application of the Sequential Test and any local information or consultations with the LLFA should be considered.

This SFRA provides the main evidence required to carry out this process. The process also enables those sites that have passed the Sequential Test, and may require the Exception Test, to be identified.

27 Applying the Sequential Test in the preparation of a Local Plan

Following application of the Sequential Test, the LPAs and developers should refer to 'Table 3: Flood risk vulnerability and flood zone 'compatibility'' of the FRCC-PPG (Paragraph 067) when deciding whether a development may be suitable or not.

The NPPF para 160 states:

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

For the exception test to be passed it should be demonstrated that:

a. *the development would provide wider sustainability benefits to the community that outweigh the flood risk; and*
b. *the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

Both elements of the exception test should be satisfied for development to be allocated or permitted." (para 161).

Although passing the Exception Test will require the completion of a site-specific FRA, the LPAs may be able to assess, for a number of sites, the **likelihood** of passing the test at the GMSF and local plan level by using this Level 1 SFRA to broadly answer the questions below. Based on the information contained in this Level 1 SFRA:

a. Can development within higher risk areas be avoided or substituted?

b. Is the flood risk associated with possible development sites considered too high and could this mean that the criteria for passing the Exception Test are unachievable?

c. Does it appear likely that risk can be sustainably managed through appropriate development techniques (resilience and resistance) and incorporate SuDS without compromising the viability of the development? (i.e. is the site large enough? are the ground conditions suitable?)

d. Is it likely that the site, and any identified residual risks to the site, can be safely managed to ensure that its occupiers remain safe during times of flood if developed?

To fully answer questions b to d, further, more detailed assessment may

Where it is found to be unlikely that the Exception Test can be passed due to:

- few wider sustainability benefits,
- the risk of flooding being too great, or
- the viability of the site being compromised by the level of flood risk management work required,

then the LPA should consider avoiding the site altogether.

Once this process has been completed, the LPAs should then be able to allocate appropriate development sites through the GMSF. They should also be able to agree 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 (see Section 7.6.4).

7.6 Summary of strategic recommendations

There are several outcomes which could come out of the sequential testing process and the surface water risk assessment. Each outcome is discussed below.

Also, as stated in Section 7.1, each LPA should refer to Appendices A to C, for details on the sites assessments carried out for this SFRA.

7.6.1 Rejection of site

- A site which fails to pass the Sequential Test, and / or the Exception Test would be rejected.
- Rejection would also apply to any highly (gypsy and traveller sites), more (residential, mixed use inclusive of residential) or less vulnerable (employment) sites within Flood Zone 3b where development should not be permitted.
- The FRCC-PPG flood risk vulnerability classification states that only water-compatible uses and essential infrastructure should be permitted in Flood Zone 3b. Any essential infrastructure must pass the Exception Test and clearly demonstrate that it does not increase or exacerbate flood risk elsewhere.
- If the developer can avoid Flood Zone 3b, part of the site could still be delivered.

7.6.2 Exception Test required if site passes Sequential Test

- Applies to those sites that, according to the FRCC-PPG vulnerability tables, would require the Exception Test, having already passed the Sequential Test.
- Only water-compatible and less vulnerable uses of land would not require the Exception Test in Flood Zone 3a.
- More vulnerable uses, including residential, and essential infrastructure are only permitted if the Exception Test is passed and all development proposals in Flood Zone 3a must be accompanied by a Flood Risk Assessment.

- To avoid having to apply the Exception Test, the developer / LPA should attempt to avoid the risk area altogether.

7.6.3 Consideration of site layout and design

- Site layout and site design is important at the site planning stage where flood risk exists.
- The site area would have to be large enough to enable any alteration of the developable area of the site to remove development from the functional floodplain, or to leave space for on-site storage of flood water.
- Careful layout and design at the site planning stage may apply to such sites where it is considered viable based on the level of risk.
- As discussed in Section 4.6.1, the revised NPPF (2019) states that safe access and escape routes should now be established as part of an emergency plan. This should be factored into early site design and should be assessed through the FRA.
- Depending on local circumstances, if it is not possible to adjust the site boundary to remove the site footprint from Flood Zone 3b to a lower risk zone then development should not be permitted.
- If it is not possible to adjust the developable area of a site to remove the proposed development from Flood Zone 3a to a lower risk zone or to incorporate the on-site storage of water within site design, then the Exception Test would have to be passed as part of a site-specific Flood Risk Assessment.
- Any site layout and design options should take account of the 8 metre buffer along watercourses, from the top of the bank or the landward toe of a defence on main rivers, where development is not permitted. This buffer is recommended by the EA to allow ease of access to watercourses for maintenance works.
- Any site redesign, where Flood Zone 3a is included within the site footprint, should allow water to flow naturally or be stored in times of flood through application of appropriate SuDS techniques (see Section 7.11).

- As per the NPPF, where development must be located in an area of flood risk, the design and layout of the development must include consideration of appropriate flood resilience and resistance measures.

For sites identified to be at significant surface water flood risk by way of the RoFSW dataset, detailed surface water flood modelling should be carried out. This is to ascertain the viability of the development and to investigate the feasibility of on-site storage and opportunities for suitable SuDS.

See Section 7.11 for information on SuDS and the SuDS hierarchy.

Also, Appendix F details different SuDS techniques and suitability.

7.6.4 Site-specific Flood Risk Assessment

According to the FRCC-PPG (Para 030), a site-specific FRA is:

"…*carried out by (or on behalf of) a developer to assess the flood risk to and from a development site. Where necessary (see footnote 50 in the National Planning Policy Framework), the assessment should accompany a planning application submitted to the local planning authority.*

The assessment should demonstrate to the decision-maker how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users (see Table 2 – Flood Risk Vulnerability of FRCC-PPG)."

The objectives of a site-specific FRA are to establish:

Whether a proposed development is likely to be affected by current or future flooding (including effects of climate change) from any source. This should include referencing this SFRA to establish sources of flooding.
Further analysis should be performed to improve understanding of flood risk including agreement with the council on areas of functional floodplain that have not been specified within this SFRA.

Key objectives:

- Whether the development will increase flood risk elsewhere;
- Whether the measures proposed to deal with these effects and risks are appropriate;
- The evidence for the local planning authority to apply (if necessary) the Sequential Test; and
- Whether the development will be safe and pass the Exception Test, if applicable.

When is a site-specific FRA required?

According to the NPPF (2019) footnote 50, a site-specific FRA should be prepared when the application site is:

- Situated in Flood Zone 2 and 3; for all proposals for new development (including minor development and change of use);
- 1 hectare or greater in size and located in Flood Zone 1;
- Located in Flood Zone 1 on land which has been identified by the EA as having critical drainage problems (i.e. within a ACDP);
- Land identified in the SFRA as being at increased flood risk in future (see Appendix B and various sections throughout this report);
- At risk of flooding from other sources of flooding, such as those identified in this SFRA; or
- Subject to a change of use to a higher vulnerability classification which may be subject to other sources of flooding.

Optionally, the LPA may also like to consider further options for stipulating FRA requirements, such as:

- Situated in an area currently benefitting from defences;
- Within a council designated CDA or OAFCDM; or
- Situated over a culverted watercourse or where development will require controlling the flow of any river or stream or the development could potentially change structures known to influence flood flow.

These further options should be considered during the preparation and development of the GMSF and local plans.

- Paragraph 031 of the FRCC-PPG contains information regarding the level of detail required. It explains that FRAs should always be proportionate to the degree of flood risk whilst making use of existing information, including this SFRA.

- Paragraph 068 of the FRCC-PPG contains an easy to follow FRA checklist for developers to follow.
- Together with the information in the FRCC-PPG, there is further detail and support provided for the LPA and developers in the EA's FRA guidance[28] and the EA guidance for FRAs for planning applications[29].
- CIRIA's report 'C624 Development and Flood Risk[30]' also provides useful guidance for developers and the construction industry.
- Section 7.6.4 of this report provides further guidance on FRAs for developers.

7.6.5 Sites passing the Sequential and Exception Tests

- Development sites can be allocated or granted planning permission where the Sequential Test and the Exception Test (if required) are passed.
- In addition, a site is likely to be allocated without the need to assess flood risk where the proposed use is for open space only. Assuming the site is not to include any development and is to be left open then the allocation is likely to be acceptable from a flood risk point of view.
- However, for sites where there is potential for flood storage, options should be explored as part of an FRA.
- In terms of opportunities for reducing flood risk overall as a requirement of the Exception Test, the FRCC-PPG states:

"Local authorities and developers should seek opportunities to reduce the overall level of flood risk in the area and beyond. This can be achieved, for instance, through the layout and form of development, including green infrastructure and the appropriate application of sustainable drainage systems, through

28 Review individual flood risk assessments: standing advice for local planning authorities

29 Flood risk assessments if you're applying for planning permission

30 CIRIA C624 Development and Flood Risk - guidance for the construction industry. 2004

safeguarding land for flood risk management, or where appropriate, through designing off-site works required to protect and support development in ways that benefit the area more generally." (Paragraph 50).

7.6.6 Surface water risk to potential sites

For sites at surface water flood risk the following should be considered:

- Critical Drainage Areas - is the site within a CDA or OAFCDM? If so what, if any, are the requirements of the LPA for sites within a CDA or OAFCDM? (see Sections 4.7.3 and 6.4.3);
- A detailed site-specific FRA incorporating surface water flood risk management or drainage strategy for larger strategic sites or clusters of sites;
- A FRA may want to consider detailed surface water modelling for sites at significant risk, particularly for larger sites which may influence sites elsewhere;
- The size of development and the possibility of increased surface water flood risk caused by development on current Greenfield land (where applicable), and cumulative impacts of this within specific areas;
- Management and re-use of surface water on-site, assuming the site is large enough to facilitate this and achieve effective mitigation. Effective surface water management should ensure risks on and off site are controlled;
- Larger sites could leave surface water flood prone areas as open greenspace, incorporating social and environmental benefits;
- SuDS should be used where possible:
    - Appropriate SuDS may offer opportunities to control runoff to Greenfield rates or better.
    - Restrictions on surface water runoff from new development should be incorporated into the development planning stage.
    - For brownfield sites, where current infrastructure may be staying in place, runoff should attempt to mimic that of Greenfield rates,

unless it can be demonstrated that this is unachievable or hydraulically impractical.

- Developers should refer to the national 'non-statutory technical standards for sustainable drainage systems' and other guidance documents cited in Section 7.11 of this report;

- Runoff up to and including the 1 in 100 AEP event should be managed on site where possible;
- Measures of source control should be required for development sites;
- Developers should be required to set part of their site aside for surface water management, to contribute to flood risk management in the wider area and supplement green infrastructure networks;
- Developers should be required to maximise permeable surfaces; and
- Flow routes on new development where the sewerage system surcharges as a consequence of exceedance of the 1 in 30 AEP design event should be retained.

7.7 Integrated Assessment and flood risk

The Integrated Assessment (see Section 5.1.1) should help to ensure that flood risk is taken into account at all stages of the planning process with a view to directing development away from areas at flood risk, now and in the future, by following the sequential approach to site allocation, as shown in Figure 7-5.

By avoiding sites identified in this SFRA as being at significant flood risk, or by considering how changes in site layout can help to avoid those parts of a site at flood risk, the Combined Authority would be demonstrating a sustainable approach to development.

In terms of surface water, for those sites at highest risk, more detailed and site-specific modelling of the risk will be required to determine the viability of development.

For all sites at risk from surface water, site design and layout should be tailored to ensure sustainable development. This should involve investigation into appropriate SuDS techniques (see Section 7.11 and Appendix F).

Appendix C contains the site summary reports on development viability recommendations for each LA.

Once the LPAs have decided on a final list of sites following application of the Sequential Test and, where required, the Exception Test following a site-specific FRA, a phased approach to development should be carried out to avoid any cumulative impacts that multiple developments may have on flood risk.

For example, for any site where it is required to develop in Flood Zone 3, detailed modelling would be required to ascertain where water displaced by development may flow and to calculate subsequent increases in downstream flood volumes. The modelling should investigate scenarios based on compensatory storage techniques to ensure that downstream or nearby sites are not adversely affected by development on other sites.

Using a phased approach to development, based on modelling results of floodwater storage options, should ensure that any sites at risk of causing flooding to other sites are developed first. This will help to ensure flood storage measures are in place before other sites are developed, thus ensuring a sustainable approach to site development.

Also, it may be possible that flood mitigation measures put in place at sites upstream could alleviate flooding at downstream or nearby sites.

Large strategic multiple development sites should also carry out development phasing within the overall site boundary to avoid cumulative impacts within the site, as well as off the site.

7.8 Cumulative impacts

The NPPF (2019) 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 156)

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, the cumulative impact may be to change the flood response of the catchment.

This SFRA considers cumulative impacts of new development through much of the advice provided on mitigation throughout Section 0 of this report and also through the accompanying SFRMF.

Consideration is given to the following:

- The importance of phasing of development, as discussed in Section 7.7;
- Cross boundary impacts (see Figure 3-7 of the SFRMF) i.e. there should be dialogue between the GMCA and the authorities upstream of GM such as Rossendale; Kirklees; High Peaks; Cheshire East; Blackburn with Darwen; and Chorley.

  Decisions on flood risk management practices and development in these authorities should involve discussion with GM given the possible downstream impacts of development of flood risk in GM.

  The same also applies to the downstream authorities of Warrington; St Helens; West Lancashire; and Calderdale which may be affected by flood risk management and development in GM.

  Section 3.5 of the SFRMF document covers cross boundary impacts more fully;
- Leaving space for floodwater, utilising greenspace for flood storage and slowing the flow, as discussed in Sections 4.4, 6.8.4, 6.8.5, 7.3.4 and Appendix B; and
- SuDS and containment of surface water on-site as opposed to directing elsewhere (see Section 7.11).

However detailed conclusions on cumulative effect would require certainty on:

- which potential development sites would be likely to be allocated,
- the size/density of the plots within a development, and
- potentially hydraulic modelling to test impacts downstream.

7.9 Guidance for developers

This SFRA provides the evidence base for developers to assess flood risk at a strategic level and to determine the requirements of an appropriate site-specific FRA.

Before carrying out an FRA, developers should check with the relevant LPA whether the Sequential Test has been carried out. If not, the developer must apply the Sequential Test as part of their FRA by comparing their proposed development site with other available sites to ascertain which site has the lowest flood risk.

The EA provides advice on this via: Flood risk assessment: the sequential test for applicants

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

- ***Identify whether the site is***
    - *A windfall development, allocated development, within a regeneration area, single property or subject to a change of use to identify if the Sequential and Exception Tests are required.*
- ***Check whether the Sequential Test and / or the Exception Test have already been applied (see Figure 7-6)***
    - *Request information from the LPA on whether the Sequential Test, or the likelihood of the site passing the Exception Test, have been assessed;*
    - *If not, provide evidence to the LPA that the site passes the Sequential Test and will pass the Exception Test.*
- ***Consult with the LPA, the LLFA and the EA and the wider group of flood risk consultees, where appropriate, to scope an appropriate FRA if required***
    - *Guidance on FRAs provided in Section 7.6.4 of this SFRA;*
    - *Also, refer to the EA Standing Advice, CIRIA Report C624, the NPPF and the FRCC-PPG;*
    - *Consult the relevant LLFA.*
- ***Submit FRA to the relevant LPA and the EA for approval, where necessary***

Table 7-13 identifies, for developers, when the Sequential and Exception Tests are required for certain types of development and who is responsible for providing the evidence and those who should apply the tests if required.

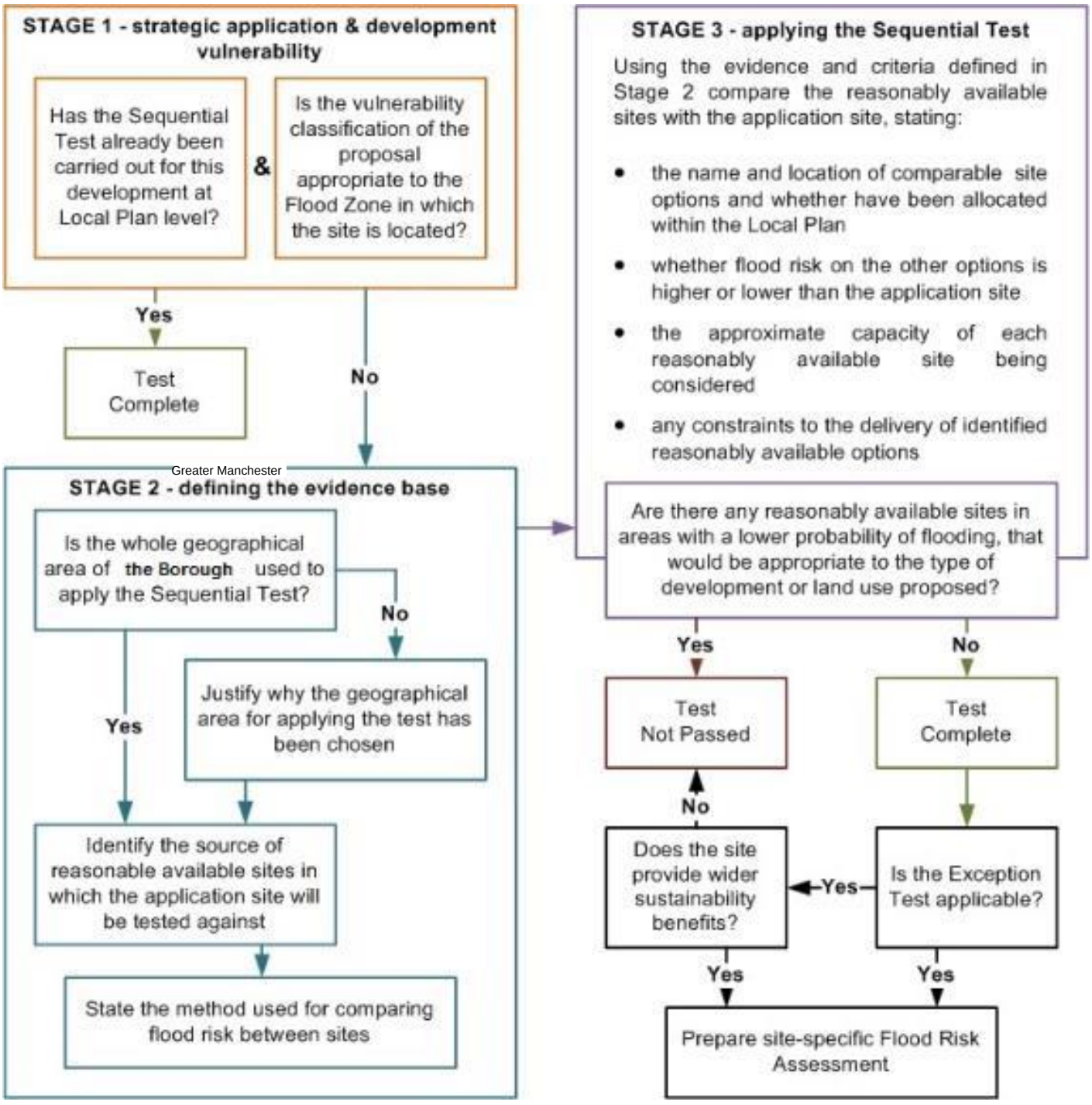
Table 7-13: Development types and application of Sequential and Exception Tests for developers

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

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

Figure 7-6 shows what developers should do with regards to applying the Sequential Test if the LPA has not already done so.

Figure 7-6: Development management Sequential Test process



The Sequential Test does not apply to change of use applications unless it is for change of land use to a caravan, camping or chalet site, or to a mobile home site or park home site.

The Sequential Test can also be considered adequately demonstrated if both of the following criteria are met:

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

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

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

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

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

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

The LPA should now have sufficient information to be able to assess whether the proposed site has passed the Sequential Test. If the Test has been passed, then the developer should apply the Exception Test in the circumstances set out by tables 1 and 3 of the FRCC-PPG.

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

More detailed guidance on site-specific FRAs is provided in Section 7.6.4.

In addition to the formal Sequential Test, the NPPF sets out the requirement for developers to apply the sequential approach to locating development within the site.

As part of their application and masterplanning discussions with applicants, the LPAs should seek whether:

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

7.10 Property Flood Resilience (PFR)

- Flood resilience and resistance measures are designed to mitigate flood risk and reduce damage and adverse consequences to existing property.
- Resistance and resilience measures may aim to help residents and businesses recover more quickly following a flood event.
- It should be noted that it is not possible to completely prevent flooding to all communities and business.
- The then Department for Communities and Local Government (DCLG), now the Ministry of Housing, Communities and Local Government (MHCLG), and the EA carried out joint research.
- This research recommended that the use of resistance measures should generally be limited to a nominal protection height of 600 millimetres above ground level. Ground level being the lowest point of ground abutting the external property walls. This is because the structural integrity of the property may be compromised above this level.
- It should be noted that PFR measures would not be expected to cause an increase in flood risk to other properties or other parts of the local community. They will help mitigate against flood risk but, as with any flood alleviation scheme, flood risk cannot be removed completely. Emergency

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

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

7.10.1 Definitions

- Flood resilience measures aim to reduce the damage caused by floodwater entering a property.
- Flood resilience measures are based on an understanding that internal flooding may occur again and when considering this eventuality, homes and businesses are encouraged to plan for flooding with an aim of rapid recovery and the return of the property to a habitable state.
- For example:
    - tiled floors are easier to clean than carpets,
    - raised electricity sockets and high-level wall fixings for TVs / computers may mean that that power supply remains unaffected,
    - Raising kitchen or storage units may also prevent damage that may not require replacement after a flood.
- There is a lot of information available about what items get damaged by floodwater and features that are considered to provide effective resilience measures that can be installed at a property.
- Flood resistance measures aim to reduce the amount of floodwater entering the property.
- Obvious inflow routes, such as through doors and airbricks may be managed, for example, by installing bespoke flood doors, door flood barriers and automatic closing airbricks.
- However, the property's condition and construction are also key to understanding how floodwater may enter and move between buildings. For example, flood water can also flow between properties through

connecting cavity walls, cellars, beneath suspended floors and through internal walls.

- Flood resistance measures alone may not keep floodwater out. Building condition is a critical component of any flood mitigation study.

7.10.2 Property Mitigation Surveys

To define the scale and type of resistance or resilience measures required, a survey will need to be undertaken to ascertain:

- property threshold levels,
- air brick levels,
- doorways, historic flood levels and
- several ground spot levels required to better understand the flood mechanisms for flood water arriving at the property (e.g. along road, pavements, etc.).

The depth of flooding at each property will help guide the selection of resistance measures proposed. Surveys will need to include consideration of issues such as:

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

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

The NPPF (2019) states that, where development must be located in an area of flood risk, following application and passing of the Sequential and Exception Tests (if applicable), the development must be appropriately flood resistant and resilient (para 163b).

7.11 Sustainable Drainage Systems (SuDS)

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

Managing surface water discharges from new development is therefore crucial in managing and reducing flood risk to new and existing development downstream. Carefully planned development can also play a role in reducing the amount of properties that are directly at risk from surface water flooding.

The then DCLG (now MHCLG) announced, in December 2014, that local planners should be responsible for delivering SuDS.

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', published in March 2015.

A Practice Guidance document has also been developed by the Local Authority SuDS Officer Organisation (LASOO) to assist in the application of the non-statutory technical standards.

7.11.1 SuDS and the revised NPPF, 2019

The Revised NPPF (2019), para 165, 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*".

As since 2014, the NPPF still states only 'major' developments should incorporate SuDS. However, all developments, both major and minor, can include SuDS, providing multiple benefits that contribute to many other NPPF policies, including climate change.

Where site conditions may be more challenging, the type of SuDS may need to be adapted to the site's opportunities and constraints. At a strategic level, this should mean identifying SuDS opportunities 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 adoption and maintenance.**

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

Maintenance options:

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

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.

Appendix F provides details on SuDS options and suitability.

7.11.2 SuDS hierarchy

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

1. To ground;
2. To surface water body;
3. To surface water sewer;
4. To combined sewer.

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

GMCA has carried out a site suitability assessment on the GMSF allocations and Call for Sites submissions to consider whether a site is in or near to a SPZ (see Section 6.5.1).

Developers should also establish that proposed outfalls are hydraulically capable of accepting the runoff from SuDS through consultation with the LLFA, EA and UU.

The non-statutory technical standards for sustainable drainage systems (March 2015) sets out appropriate design criteria based on the following:

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

In addition, the LPA may set local requirements for planning permission that include more rigorous obligations than these non-statutory technical standards.

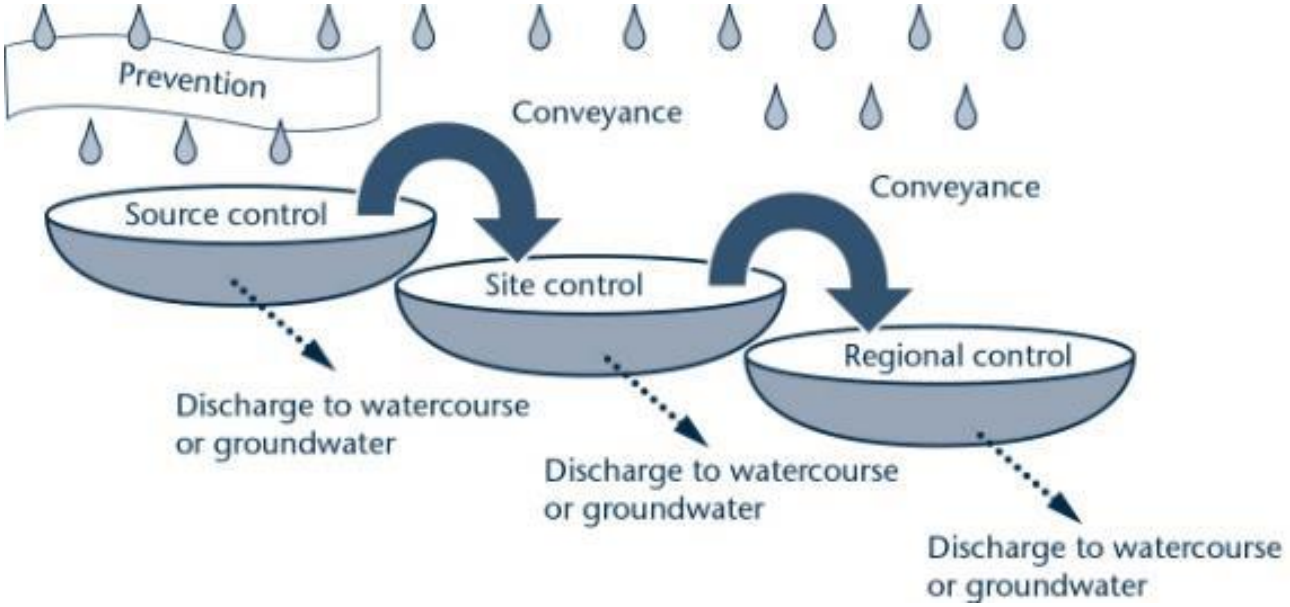
More stringent requirements should be considered where current Greenfield sites lie upstream of high risk areas. This could include improvements on Greenfield runoff rates.

CIRIA has also produced several guidance documents relating to SuDS that should be consulted by the LPA and developers.

Also, as referenced in Section 6.8.4, the LPAs should utilise the Local Action ToolKit[31] available online.

Many different SuDS techniques can be implemented. As a result, there is no one standard correct drainage solution for a site. In most cases, a combination of techniques, using the Management Train principle (see Figure 7-7), will be required, where source control is the primary aim.

Figure 7-7: SuDS Management Train Principle[32]



31 Local Action ToolKit

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

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.

7.11.3 Drainage for new developments

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

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

Carefully planned development can also play a role in reducing the amount of properties that are directly at risk from surface water flooding.

The Planning System has a key role to play in setting standards for sustainable drainage from new developments and ensuring that developments are designed to take account of the risk from surface water flooding.

Sustainable drainage plays an important part in reducing flows in the sewer network and in meeting environmental targets, alongside investment in maintenance by the water companies on their assets.

Water companies plan their investment on a five-year rolling cycle, in consultation with key partners, including the EA.

7.11.4 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 FRA, the likely extents, depths and associated hazards of surface water flooding on a development site, as shown by the RoFSW dataset. This is an appropriate approach to reduce the risk of flooding to new developments.

Green infrastructure should be used wherever possible to accommodate such flow paths. **Floor levels should always be set a minimum of 300 mm above adjacent roads** to reduce the consequences of any localised flooding.

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 on-site 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.

8 Emergency planning

The provisions for emergency planning for local authorities as Category 1 responders are set out by the Civil Contingencies Act, 2004 and the National Flood Emergency Framework for England, December 2014[33].

This framework is a resource for all involved in emergency planning and response to flooding from the sea, rivers, surface water, groundwater, and reservoirs.

The Framework sets out Government's strategic approach to:

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

Along with the EA flood warning systems, there are a range of flood plans at a sub-regional and local level, outlining the major risk of flooding and the strategic and tactical response framework for key responders.

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 A and accompanying GIS layers should be made available for consultation by emergency planners during an event and throughout the planning process.

33 The national flood emergency framework for England

8.1 Civil Contingencies Act

Under the Civil Contingencies Act (CCA, 2004)[34], the LLFA and LPAs are classified as Category 1 responders and thus have duties to assess the risk of emergencies occurring, and use this to:

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

8.1.1 Greater Manchester Resilience Forum

The ten GM authorities (LPAs and LLFAs), are partners of the Greater Manchester Resilience Forum (GMRF)[35].

The role of the GMRF is to ensure an appropriate level of preparedness to enable an effective multi-agency response to emergency incidents that may have a significant impact on the communities within GM.

The GMRF consists of Category 1 and Category 2 responders.

34 Civil Contingencies Act

35 Greater Manchester Resilience Forum

Category 1 responders include representatives from:

- the Emergency Services,
- the GM local authorities,
- Department for Communities and Local Government,
- the EA,
- NHS England and
- Public Health England.

Category 2 responders include:

- Highways England,
- Network Rail,
- United Utilities and
- National Grid.

8.1.1.1 GM Community Risk Register

As a strategic decision-making organisation, the GMRF prepared a Community Risk Register (CRR)[36], last updated in September 2015.

The CRR considers the likelihood and consequences of the most significant risks and hazards the area faces, including fluvial and urban flooding. This SFRA can help to inform this.

The CRR is considered as the first step in the emergency planning process and is designed to reassure the local community that measures and plans are in place to respond to the potential hazards listed within the CRR.

8.1.1.2 Community Emergency Planning

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.

36 Community Risk Register

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[37].

The UK Government has produced several useful guidance documents to enable individuals, communities and organisations to be more resilient and support one another: Community resilience: resources and tools

These online resources have been developed to enable individuals, communities and the organisations that support them to take part in emergency preparedness activities, in a way that complements the work of emergency responders.

The Met Office have also produced some useful information on how communities can be better prepared for extreme weather events: Community resilience

8.1.1.3 Post flooding guidance

The GMRF provides some useful information and guidance for both residents and businesses that may have been affected by flooding: Know your risks: flooding

8.1.2 Local Flood Plans

This SFRA provides several flood risk data sources that should be used when producing or updating flood plans. GMCA will be unable to write their own specific flood plans for new developments at flood risk. Developers should write their own.

Generally, owners with individual properties at risk should write their own individual flood plans, however larger developments, or regeneration areas, such as retail parks, hotels and leisure complexes, should consider writing one collective plan for the assets within an area.

This SFRA can help to:

- Update these flood plans if appropriate;
- Inform emergency planners in understanding the possibility, likelihood and spatial distribution of all sources of flooding (emergency planners may

37 Community resilience

however have access to more detailed information, such as the EA's Reservoir Flood Maps, which have not been made available for this SFRA);

- Identify safe evacuation routes and access routes for emergency services;
- Identify key strategic locations to be protected in flooding emergencies, and the locations of refuge areas which are capable of remaining operational during flood events;
- Provide information on risks in relation to key infrastructure, and any risk management activities, plans or business continuity arrangements;
- Raise awareness and engage local communities;
- Support emergency responders in planning for and delivering a proportionate, scalable, and flexible response to the level of risk; and
- Provide flood risk evidence for further studies.

8.2 Flood Warning and evacuation plans

Developments that include areas that are designed to flood (e.g. ground floor car parking and amenity areas) or have a residual risk associated with them, will need to provide appropriate flood warning and instructions so users and residents are safe in a flood.

This will include both physical warning signs and written flood warning and evacuation plans. Those using the new development should be made aware of any evacuation plans.

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

Whilst there is no statutory requirement on the EA or the emergency services to approve evacuation plans, LPAs are accountable under their Civil Contingencies duties, via planning condition or agreement, to ensure that plans are suitable. This should be done in consultation with development management officers.

Given the cross cutting nature of flooding, it is recommended that further discussions are held internally in GMCA between emergency planners and policy planners / development management officers, the LLFAs, drainage engineers and also to external stakeholders such as the emergency services, the EA, UU, any Internal Drainage Boards, the Peel Group 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.

The application of such a condition is likely to require policy support in the GMSF, and discussions within the GMRF are essential to establish the feasibility / effectiveness of such an approach, prior to it being progressed.

It may also be useful to consider how key parts of agreed flood evacuation plans could be incorporated within local development documents, including in terms of protecting evacuation routes and assembly areas from inappropriate development.

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

8.2.1 What should the Plan Include?

Flood warning and evacuation plans should include the information stated in Table 8-1. Advice and guidance on plans are accessible from the EA website and there are templates available for businesses and local communities.

Table 8-1: 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	The rate of onset is how quickly the water arrives

Consideration	Purpose
flooding	and the speed at which it rises which, in turn, will govern the opportunity for people to effectively prepare for and respond to a flood. This is an important factor within Emergency Planning in assessing the response time available to the emergency services.
How flood warning is given and occupants awareness of the likely frequency and duration of flood events	Everyone eligible to receive flood warnings should be signed up to the EA flood warning service. Where applicable, the display of flood warning signs should be considered. In particular sites that will be visited by members of the public on a daily basis such as sports complexes, car parks, retail stores. It is envisaged that the responsibility should fall upon the developers and should be a condition of the planning permission. Information should be provided to new occupants of houses concerning the level of risk and subsequent procedures if a flood occurs.
The availability of staff / occupants / users to respond to a flood warning and the time taken to respond to a flood warning	The plan should identify roles and responsibilities of all responders. The use of community flood wardens should also be considered.
Designing and locating safe access routes, preparing evacuation routes and the identification of safe locations for	Dry routes will be critical for people to evacuate as well as emergency services entering the site. The extent, depth and flood hazard rating, including allowance for climate change, should be considered when identifying these routes.

Consideration	Purpose
evacuees	
Vulnerability of occupants	Vulnerability classifications associated with development as outlined in the FRCC-PPG. This is closely linked to its occupiers.
How easily damaged items will be relocated, and the expected time taken to re-establish normal use following an event	The impact of flooding can be long lasting well after the event has taken place affecting both the property which has been flooded and the lives that have been disrupted. The resilience of the community to get back to normal will be important including time taken to repair / replace damages.

8.2.2 EA Flood Warning Areas

The EA monitors levels within main rivers and the sea, based upon weather predictions provided by The Met Office. The EA then 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 the inundation of a populated area, the EA will issue a series of flood warnings within defined Flood Warning Areas (FWA). The warnings will alert people that flooding is **expected** to occur and that they should take action to protect themselves and their property.

Severe Flood Warnings are issued for FWAs when there is a danger to life or widespread disruption is expected.

More information on flood warning is provided by the EA via: Flood warnings: what they are and what to do

There are several FWAs in operation across GM which are shown on the SFRA Maps in Appendix A.

8.2.3 EA Flood Alert Areas

Conversely to Flood Warnings, a Flood Alert is issued to warn people of the **possibility** of flooding and to encourage them to be alert, stay vigilant and make early / low impact preparations for flooding.

Flood Alerts are issued earlier than Flood Warnings to provide advance notice of the possibility of flooding and may be issued when there is less confidence that flooding will occur in a FWA.

A single Flood Alert Area (FAA) may cover a large portion of a floodplain, may contain multiple river catchments of similar characteristics, and may contain several FWAs.

A FAA may also match a single corresponding FWA and warn for the possibility of flooding in that area. In some coastal locations, a Flood Alert may be issued for spray or overtopping and be defined by a stretch of coastline.

The FAAs within GM are also included on the SFRA Maps.

8.2.4 EA flood information service

Live information on Flood Warnings and Flood Alerts is available via: Flood warnings for England

As discussed, emergency planners may also use the outputs from this SFRA to raise awareness within local communities. This should include raising awareness of flood risks, roles and responsibilities and measures that people can take to make their homes and businesses more resilient to flooding from all sources.

At risk local communities should be encouraged to sign up to the EA's Flood Warning service online via: Sign up for flood warnings

It is also recommended that Category 1 responders (see Section 8.1.1) are provided with appropriate flood response training to help prepare them for the possibility of a major flood. As there is an increased number of people living within flood risk areas, to ensure that adequate pre-planning, response and recovery arrangements are suitably in place.

9 Conclusions and recommendations

9.1 Conclusions

This Level 1 SFRA provides a single repository planning tool relating to flood risk and development in Greater Manchester.

Key flood risk stakeholders namely the LPAs and LLFAs within GM, the EA, UU and the Canal & River Trust were consulted to collate all available and relevant flood risk information on all sources into one comprehensive assessment.

Together with this report, this SFRA also provides:

- a suite of interactive GeoPDF flood risk maps (Appendix A);
- Development Site Assessment spreadsheets (Appendix B) illustrating the level of risk to sites with subsequent strategic recommendations;
- site summary reports (Appendix C) summarising the strategic recommendations.

The flood risk information, assessment, guidance and recommendations of the SFRA will provide GMCA with the evidence base required to apply the Sequential Test. It will also provide information on the application of the Exception Test, as required under the NPPF.

It will help demonstrate that a risk based, sequential approach has been applied to achieve sustainable development through the GMSF.

Whilst the aim of the sequential approach is the avoidance of high flood risk areas, where GMCA are looking for continued growth, this will not always be possible.

This SFRA, together with the proposed GM Strategic Framework for Flood Risk Management, therefore, provides the necessary links between:

- spatial development,
- wider flood risk management policies,
- local strategies / 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. For a more detailed assessment of specific areas or sites, a Level 2 SFRA may be carried out following on from this Level 1 assessment.

9.2 Planning policy and flood risk recommendations

The following planning policy recommendations relating to flood risk are designed to enable GMCA to translate the information provided in this Level 1 SFRA into meaningful policy for flood risk and water management within the GMSF:

Policy Recommendation 1: No development within Flood Zone 3b…

…as per the NPPF and FRCC-PPG, unless in exceptional circumstances such as for essential infrastructure, which must still pass the Exception Test, or where development is water compatible.

Development must not impede the flow of water within Flood Zone 3b nor should it reduce the volume available for the storage of floodwater.

Sites within Flood Zone 3b may still be developable if the site boundary can be removed from the floodplain or the site can accommodate the risk on site and keep the area free from development.

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

Policy Recommendation 2: Consider surface water flood risk…

…with equal importance alongside fluvial risk including possible withdrawal, redesign, or relocation for sites at significant surface water risk. **However, given the limitations of the RoFSW map, decisions on withdrawal or relocation of sites due to surface water risk can only take place following more detailed investigation / modelling after this Level 1 SFRA**.

All new development should adhere to the applicable runoff rate allowances stated by the LLFA.

Any new development within a CDA or a OAFCDM (at the discretion of the LPA) should adhere to runoff restrictions specified by the applicable LPA.

FRAs should always consider surface water flood risk management and options for on-site flood storage.

Policy Recommendation 3: Sequential approach to site allocation and site layout…

…must be followed by GMCA and the LPAs to ensure sustainable development when either allocating land through the GMSF and local plans or when determining planning applications for development.

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

Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in higher risk Flood Zone 3, be considered. This should consider the flood risk vulnerability of land uses and the likelihood of meeting the requirements of the Exception Test, if required.

This SFRA and its appendix, the NPPF and FRCC-PPG should be consulted throughout this process.

Policy Recommendation 4: Requirement for a site-specific Flood Risk Assessment…

…from a developer when a site is:

- Within Flood Zone 3a or Flood Zone 2
- Within Flood Zone 1 and 1 hectare or greater in size
- At risk from surface water flooding or on land which has been identified by the EA as having critical drainage problems (i.e. within an ACDP)
- Within a council designated CDA
- Situated in an area currently benefitting from defences
- Land identified as being at increased flood risk in future
- At risk of flooding from other sources than fluvial, or at residual risk
- Subject to a change of use to a higher vulnerability classification which may be subject to other sources of flooding
- Situated over a culverted watercourse or where development will require controlling the flow of any river or stream or the development could potentially change structures known to influence flood flow.

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

Policy Recommendation 5: Use of appropriately sourced of SuDS…

…required for all major developments of 10 or more residential units or equivalent commercial development. This is in accordance with the interim national standards published in March 2015.

As per the NPPF (2019), in terms of SuDS, development in areas at flood risk should only be permitted where SuDS are incorporated into the design, unless clear evidence suggests this would be inappropriate.

SuDS scoping and design, as part of a site-specific FRA, must be included within the early stages of the site design to incorporate appropriate SuDS within the development.

The LPA, LLFA and UU must be consulted during the site design stage and the FRA must be submitted to and approved by the relevant LPA, considering all consultation with key stakeholders.

Appropriate guidance should be followed, as referenced within this SFRA.

Policy Recommendation 6: Natural Flood Management techniques…

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

The national NFM / WwNP mapping and River Irwell data (included in this SFRA) should be checked in the first instance, followed by local investigation into whether such techniques are appropriate and whether the benefits are proportionate to the work required to carry out the identified NFM approaches.

Policy Recommendation 7: Phasing of development…

…should be carried out by the LPA to avoid any cumulative impacts of flood risk (reinforced by the revised NPPF (2019). UU's preference is for developers to provide a detailed surface water strategy for large sites to avoid piecemeal infrastructure provision.

Using a phased approach to development, should ensure that any sites at risk of causing flooding to other sites are developed first in order to ensure flood storage measures are in place before other sites are developed, thus contributing to a sustainable approach to site development.

It may be possible that flood mitigation measures put in place at sites upstream could alleviate flooding at downstream or nearby sites.

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

Policy Recommendation 8: Planning permission for at risk sites…

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

- The NPPF and FRCC-PPG have been referenced together with appropriate consultation with the relevant LPA, LLFA, the EA, and UU, where applicable
- The effects of climate change have been considered using the latest allowances developed by the EA
- There is no loss in floodplain storage resulting from the development
- The development will not increase flood risk elsewhere
- There is no adverse effect on the operational functions of any existing flood defence infrastructure
- Proposed resistance / resilience measures designed to deal with current and future risks are appropriate
- Appropriate SuDS techniques have been considered and are to be incorporated into the design of the site, where applicable
- Whether the development will be safe for its lifetime and has passed the Exception Test, if applicable
- An appropriate Emergency Plan is included that accounts for the possibility of a flood event and shows the availability of safe access and egress points accessible during times of flood.

9.3 Recommendations for further work

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

There are a number of plans and assessments listed in Table 9-1 that may be of benefit to GMCA in developing their flood risk evidence base to support the

delivery of the GMSF and the individual local plans or to help fill critical gaps in flood risk information.

9.4 Data gaps

Throughout the SFRA process it has become apparent that there are several gaps in flood risk information and data. These gaps have been noted throughout this report.

Table 9-1 lists several studies that could be carried out by GMCA, the local authorities or by private developers in future to help fill these gaps.

Table 9-1: Recommended further work for GMCA, local councils or developers based on identified data gaps

Type	Study	Explanation	Timeframe
Understanding of local flood risk	Level 1 SFRA update	As and when new potential development sites, flood risk information or policy becomes available	Short - medium term
	Level 1 SFRA update; Level 2 SFRA; site-specific FRA	Reviewing of EA flood zones in those areas not covered by existing detailed hydraulic models i.e. the Flood Map for Planning does not cover every watercourse such as those <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
	EA Flood Risk Mapping updates / Level 1 SFRA	EA model updates of older / less detailed models, i.e. conversion of 1D to 2D models. Subsequent updates to	Medium term

Type	Study	Explanation	Timeframe
	update	this Level 1 SFRA by GMCA once models are finalised	
	Level 2 SFRA	Further, more detailed assessment of flood risk to high risk sites, as notified by this Level 1 SFRA. More specific to the individual district authorities	Short term
	SWMP / drainage strategy	Update of the 2013 SWMP for those high surface water risk sites / areas as notified by this Level 1 SFRA	Short term
	Climate change assessment for Level 1 update or Level 2 SFRA	Modelling of climate change, using EA's latest allowances for those watercourses not yet modelled and taking account of updated EA allowances in late 2019 based on UKCP18	Short term
	CDAs / OAFCDMs review	Establish more robust CDA boundaries using more detailed data along with existing CDA and OAFCDM boundaries	Short term
	SuDS	Identification of SuDS opportunities according to geology, soil type, topography, groundwater / mine water conditions, etc, their potential impact on proposed development sites, and setting out of local SuDS guidance and opportunities for adoption and maintenance.	Short term
	Groundwater / mine water	Groundwater or mine water information has not been made available for this SFRA. Information on groundwater will be very localised and should be used	Short term

Type	Study	Explanation	Timeframe
		to inform on SuDS suitability.	
Flood storage and attenuation	Community Infrastructure Levy (CIL). WwNP and GI Assessment	For new developments, GI assets can be secured from a landowner's 'land value uplift' and as part of development agreements. GMCA could include capital for the purchase, design, planning and maintenance of GI within its CIL programme. Continue WwNP proposals in upper catchments. (GM SFRMF document contains more details).	Short term
Data collection	Flood incident data to be spatialised	Each LLFA has a duty to investigate and record details of locally significant flood events. General data collected for each incident should include date, location, weather conditions, flood source (if apparent without an investigation), impacts (properties flooded, or number of people affected) and response by any RMA. This data should be available spatially. Several GM councils should look to spatially represent their historic flood incident data.	Short term
	FRM Asset Register	Each LLFA should continue to update and maintain its flood risk management register of structures and features, which are considered to influence flood risk.	Short term

Type	Study	Explanation	Timeframe
Risk assessment	Asset Register Risk Assessment	Each LLFA should carry out a strategic assessment of structures and features on the FRM Asset Register to inform capital programme and prioritise maintenance programme. Critical assets (i.e. culverts in poor condition) to be prioritised for assessment and any subsequent designated works.	Short term
Capacity	SuDS review / guidance	GMCA and / or the districts should identify internal capacity required to deal with SuDS applications, set local specification and set policy for adoption and maintenance of SuDS.	Short term
Partnership	UU	GMCA should continue to work with UU on sewer and surface water projects and data sharing.	Ongoing
	EA	GMCA should continue to work with the EA on fluvial flood risk management projects. GMCA should also identify potential opportunities for joint schemes to tackle flooding from all sources.	Ongoing
	Canal & River Trust	GMCA should continue to work with the Canal & River Trust to understand the residual risks associated with the canal network and also asset owners of reservoirs.	Ongoing
	Peel Group	GMCA should continue to work with the Peel Group to understand the residual risks associated with the MSC and Bridgewater Canal.	Ongoing

Type	Study	Explanation	Timeframe
	Community	Continued involvement with the community through GMCA's existing flood risk partnerships.	Ongoing

9.4.1 Level 2 SFRA

Each GM Council should review the sites where they expect the main housing numbers and employment sites to be delivered, using the SFRA Maps in Appendix A, the Development Site Assessment spreadsheets in Appendix B and the site summary reports in Appendix C.

A Level 2 SFRA will be required if a large site, or group of sites, are within Flood Zone 3 and have strategic planning objectives, which means they cannot be relocated or avoided.

A Level 2 SFRA may also be required if most sites are within Flood Zone 2 or are at significant risk of surface water flooding, based on the RoFSW map. Residual flood risk should also be taken account of when considering options for future work.

A Level 2 SFRA should build on the source information provided in this Level 1 assessment and should show that a site will not increase risk to others and will be safe, once developed, and will pass the Exception Test, if required.

A Level 2 study may also assess locations and options for the implementation of open space, or Green Infrastructure, to help manage flood risk in key areas.

GMCA will need to provide evidence through the GMSF to show that the housing numbers (and other sites) can be delivered, as will the individual LPAs through their local plans.

The GMSF and local plans may be rejected if large numbers of sites require the Exception Test to be passed but with no evidence that this will be possible.

Once all sites within this Level 1 assessment have been reviewed by each LPA then further advice or guidance should be sought to discuss possible next steps.

Appendices

A SFRA Maps

Interactive GeoPDF Maps

B Development Site Assessment Spreadsheets

C Development Site Assessment Summary Reports

D Functional Floodplain Delineation

E EA Climate Change Modelling

F SuDS Selection Summary

F.1 SuDS Techniques

F.2 SuDS Suitability

Offices at

Coleshill

Doncaster

Dublin

Edinburgh

Exeter

Glasgow

Haywards Heath

Isle of Man

Limerick

Newcastle upon Tyne

Newport

Peterborough

Saltaire

Skipton

Tadcaster

Thirsk

Wallingford

Warrington

Registered Office
1 Broughton Park
Old Lane North
Broughton
Skipton
North Yorkshire
BD23 3FD

t:+44(0)1756 799919
e:info@jbaconsulting.com

Jeremy Benn Associates Ltd
Registered in England 3246693

JBA Group Ltd is certified to:
ISO 9001:2015
ISO 14001:2015
ISO 45001:2018

Visit our website
www.jbaconsulting.com