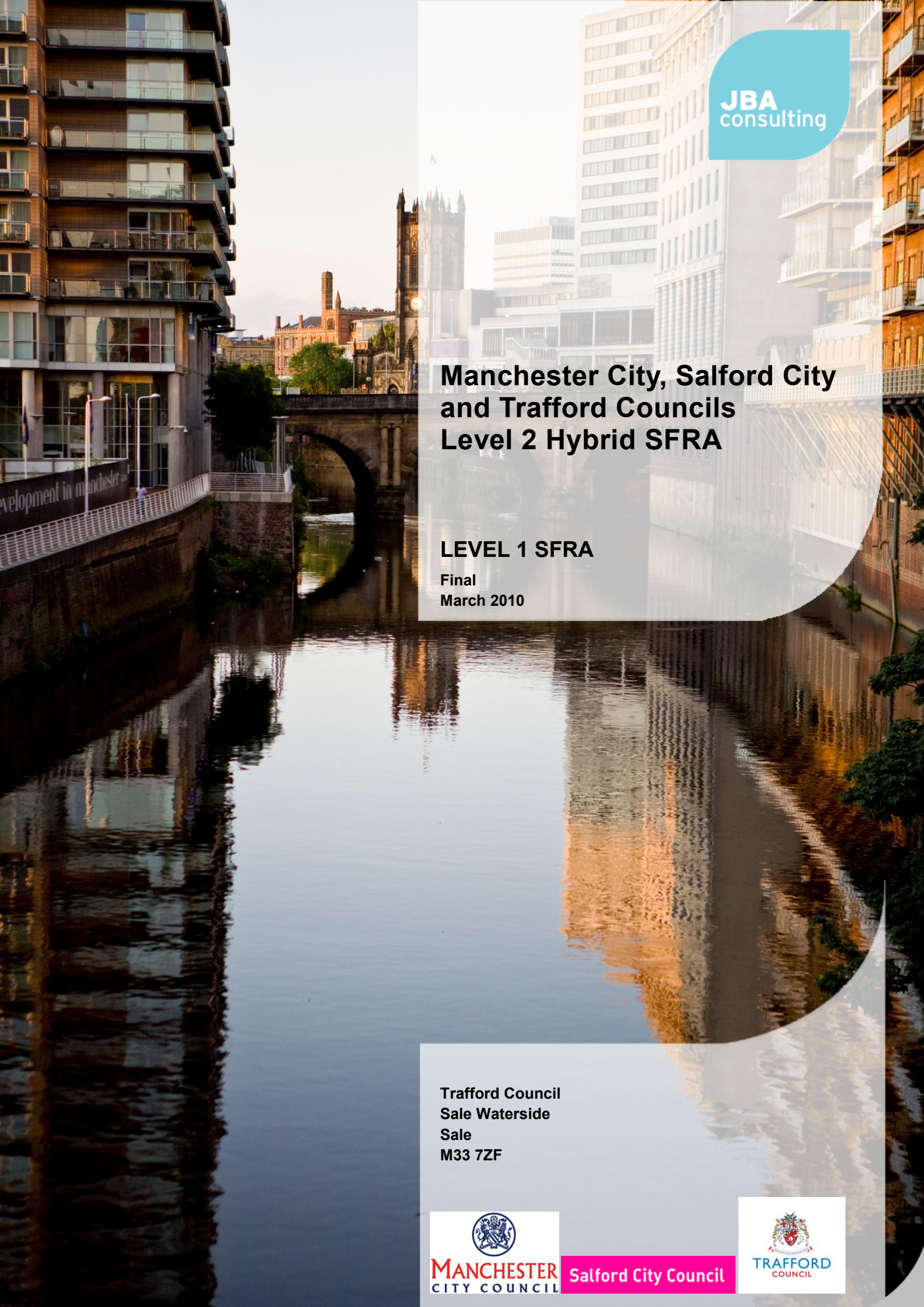

Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA

LEVEL 1 SFRA

Final
March 2010

Trafford Council
Sale Waterside
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Structure of the Manchester, Salford and Trafford SFRA

The Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA is supplied as four Volumes, described in the table below. Readers should refer to SFRA User Guide that is currently being developed for guidance on how to use the information provided in the SFRA.

SFRA Volume	Contents
User Guide	This is currently being developed and will provide detailed guidance for Spatial Planners, Development Control Officers, developers and Emergency Planners on their responsibilities within regional and local flood risk management as defined within PPS25 and the use of the SFRA as a supporting tool.
Level 1 SFRA	**The Level 1 SFRA has used mostly existing data to make an assessment of flood risk from all sources now and in the future and builds on the Association of Greater Manchester Authorities (AGMA) Sub-Regional SFRA. It looks at the risk of flooding from rivers, canals, reservoirs, groundwater and surface water and sewers. It provides evidence for LPA officers to apply the Sequential Test and identify the need to pass the Exception Test where required.**
Level 2 SFRA	The Level 2 SFRA provides more detailed information on flood risk from rivers (The Lower Irwell, Grey Irwell, Rivers Irk, Medlock and Mersey and the Corn Brook), canals (Manchester Ship Canal and the Bridgewater, Rochdale and Ashton Canals) and surface water and sewers. It also looks at the impacts of development on flood risk and the interactions between different sources of flooding. The additional detail can also inform a sequential approach to development allocation within flood risk areas, the likelihood of sites passing the Exception Test and mitigation options where appropriate.
Maps	This volume collates the map outputs for the SFRA and provides a Maps Index.

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
Draft v1.0 (October 2009)		Colin Moss (TBC), Fiona Moss (SCC), Helen Best (MCC) and Helen Telfer (EA)
Draft v2.0 (February 2010)	LPA and EA comments	Colin Moss (TBC), Fiona Moss (SCC), Helen Best (MCC) and Helen Telfer (EA)
Final (March 2010)	LPA and EA comments	Colin Moss (TBC), Fiona Moss (SCC), Helen Best (MCC) and Helen Telfer (EA)

Contract

This report describes work commissioned by Trafford Council, on behalf of Manchester City, Salford City and Trafford Councils, by a letter dated 26 May 2009. Trafford's representative for the contract was Colin Moss. Hannah O'Callaghan and Christoff Power of JBA Consulting carried out this work.

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Purpose

This document has been prepared as a Final Level 1 SFRA report for Manchester City, Salford City and Trafford Councils. 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 Manchester City, Salford City and Trafford Council.

Acknowledgments

JBA Consulting would like to acknowledge the support of the SFRA steering group: Colin Moss, Steve Hark (Trafford BC), Fiona Moss, Nigel Openshaw, Will Horsfall (Salford CC), Helen Best, Andrew Parkin (Manchester CC), Helen Telfer and Chris Waring (Environment Agency).

We would also like to thank Neil D'Arcy at British Waterways for his contribution in understanding the risk of flooding from canals and the Manchester Ship Canal Company.

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Executive Summary

Level 1 SFRA Purpose and Approach

Flood risk in Manchester, Salford and Trafford is complicated and arises from many potential sources. It is, rightly, a constraint to development and great care is needed over the type and form of new development in flood risk areas.

There is an intricate and well connected network of rivers, streams, sewers and canals within Greater Manchester. Flooding does not respect political boundaries and actions to manage flood risk and water from new development need to be carefully considered so that they do not increase risk downstream. Manchester City, Salford City and Trafford Councils and the Environment Agency should work together on flooding problems, particularly where actions could exacerbate flooding in downstream communities.

The Manchester, Salford and Trafford Level 2 Hybrid Strategic Flood Risk Assessment (SFRA) is presented across four separate report volumes:

- User Guide (this is currently being developed)
- Level 1 SFRA
- Level 2 SFRA
- Maps

The Level 1 SFRA (this volume) provides a spatial assessment of flood risk within key urban areas, which expands on the detail included in the Association of Greater Manchester Authorities (AGMA) sub-regional SFRA. Together these sources will support developing Local Development Frameworks (LDFs) and the production of policies and proposals for development within Manchester, Salford and Trafford.

This volume introduces the key sources and mechanisms of flood risk and current measures that are taken to manage the risk. The Level 1 SFRA supports the application of the Sequential Test and includes the following:

- Flood Zone Maps
- Flood Risk Management Maps
- Climate Change Maps
- Strategic Depth Maps

To aid Local Planning Authorities (LPAs) in undertaking the Sequential Test, a spreadsheet has been developed which provides a spatial assessment for each proposed development site against the risk of fluvial and surface water flooding. The analysis includes the area and percentage of each site within the Flood Zones and surface water susceptibility zones.

Flood Risk in Manchester

The main source of flood risk in Manchester is from the Grey Irwell, the Rivers Irk, Medlock and Mersey and Corn Brook. There was flooding from the Mersey in Didsbury and Northenden in 1998 and on the River Medlock in the centre of Manchester in 1991 and 2002. Surface water flooding is also significant and there is residual risk from the Ashton, Rochdale and Bridgewater Canals and several reservoirs.

Flood Risk in Salford

The main source of flood risk in Salford is from the River Irwell, Grey Irwell, Worsley Brook and the Manchester Ship Canal (MSC). There was flooding in Kersal and Lower Broughton from the Lower Irwell in 1946, 1954, 1980 and 1998, with the most recent event in 2002. Surface water flooding is also significant and there is residual risk from the Bridgewater Canal and several reservoirs.

Flood Risk in Trafford

The main source of flood risk in Trafford is from the River Mersey and the MSC. There was flooding along the Mersey in Carrington in 1998. Surface water flooding is possible and there is a residual risk from the Bridgewater Canal.

Recommendations for Level 2 Assessment

Taking into account the severity of flood risk and development needs, the Level 1 SFRA recommends that the following issues should be assessed within the Level 2 SFRA:

- Fluvial flood risk at strategic development sites along the Irwell, Irk, Medlock, Grey Irwell, Corn Brook and the Manchester Ship Canal (MSC).
- Breach of the defences on the Irwell at Kersal and Lower Broughton and on the Mersey at Carrington.
- Overtopping and breach of embankments along the Rochdale, Ashton and Bridgewater Canals.
- Detailed surface water analysis should be undertaken across the authorities to assess flood risk from this source.

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Please note that an exhaustive list of SFRA maps is provided in the Maps Volume Index.

Abbreviations

ABD	Areas Benefiting from Defences
AEP	Annual Exceedance Probability
AGMA	Association of Greater Manchester Authorities
ASSWF	Areas Susceptible to Surface Water Flooding
BHS	British Hydrological Society
BGS	British Geological Society
CDA	Critical Drainage Area
CFMP	Catchment Flood Management Plans
DEM	Digital Elevation Model
DPDs	Development Plan Documents
DTM	Digital Terrain Model
EA	Environment Agency
FSA	Flood Storage Area
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
FRM	Flood Risk Management
GEM	Groundwater Emergence Map
GI	Green Infrastructure
HMR	Housing Market Renewal
LDDs	Local Development Documents
LDF	Local Development Framework
LIDAR	Light Detection and Ranging
LPAs	Local Planning Authorities
MSC	Manchester Ship Canal
MST	Manchester Salford Trafford
NFCDD	National Flood and Coastal Defence Database
OS	Ordnance Survey
PPS	Planning Policy Statement
RFRA	Regional Flood Risk Assessment
RSS	Regional Spatial Strategy
SA	Sustainability Appraisal
SFRA	Strategic Flood Risk Assessment
SHLAA	Strategic Housing Land Availability Assessment
SoP	Standard of Protection
SPD	Supplementary Planning Document
SUDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKCIP	United Kingdom Climate Impacts Programme
UU	United Utilities
WCS	Water Cycle Study

1 Introduction

1.1 Background

JBA Consulting was commissioned in May 2009 by Manchester City, Salford City and Trafford (MST) Councils to undertake a Level 2 Hybrid Strategic Flood Risk Assessment (SFRA) following on from the Greater Manchester Sub-Regional SFRA completed in August 2008. This is a hybrid SFRA because it fills in the gaps from the Level 1 SFRA and also fulfils the criteria for a Level 2 SFRA.

The Hybrid SFRA has been prepared in accordance with current best practice, including Planning Policy Statement 25 Development and Flood Risk (PPS25)[1] and the PPS25 Practice Guide[2].

This report informs the application of the Sequential Test and helps with identifying whether the Exception Test is likely to be necessary. Existing data was used to make an assessment of flood risk from all sources now and in the future.

1.2 Level 1 SFRA scope and objectives

An SFRA is a planning tool that enables a council to select and develop more vulnerable site allocations away from areas susceptible to flooding. The assessment focuses on the emerging site allocations within the MST authorities but also sets out the procedure to be followed when assessing additional sites for development in the future.

The adopted Regional Spatial Strategy (RSS) for the North West sets out the broad scale and spatial distribution of development within the region up to 2021. The core of the Manchester City Region identified as the Regional Centre and surrounding Inner Areas, is located within Manchester, Salford and Trafford. It is the primary focus of new development within the North West in terms of policy focus and scale of development. Across the three authorities there are considerable pressures for regeneration, as well as opportunities for inward investment to support economic and housing growth. Within the strategic context of the RSS the SFRA will help guide councils in the development of their Local Development Frameworks (LDFs) and other relevant strategies, policies and actions.

In addition to informing the assessment of existing site allocations, the Level 1 and Level 2 SFRAs will inform decision making on planning applications for non-allocated sites and flood management measures to reduce flood risk to existing development and emergency planning.

[1] Communities and Local Government (2006) Planning Policy Statement 25: Development and Flood Risk
[2] Communities and Local Government (2009) Planning Policy Statement 25: Development and Flood Risk – Practice Guide

The key objectives of a SFRA are to:

- Investigate and identify the extent and severity of flood risk to the area at present and in the future, under the terms of PPS25;
- Contribute to the Council's Sustainability Appraisal (SA) and LDF;
- Enable the Council to apply the Sequential Test and the Exception Test;
- Provide strategic flood risk guidance and advice to planners and developers;
- Help LPAs to identify specific locations where further and more detailed flood risk data and assessment work is required. This includes the scope for Surface Water Management Plans (SWMPs) and/or Water Cycle Studies (WCSs);
- Identify the level of detail required for site-specific Flood Risk Assessments (FRAs);
- Inform the emergency planning process;
- Improve stakeholder joint working and the sharing of data, information and the understanding of flood risk and
- Provide a reference document.

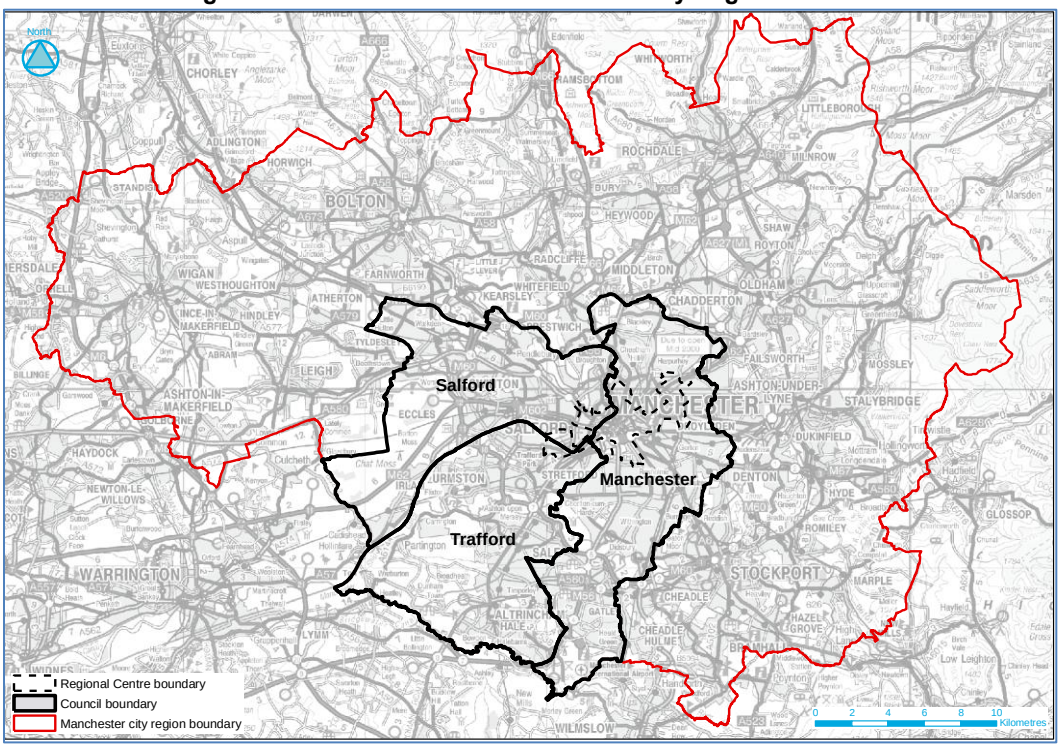
There is a trend developing since the first publication of the PPS25 Practice Guide in 2008 for SFRAs to be more than a land use planning tool and provide a broader and inclusive vehicle for integrated, strategic and local Flood Risk Management (FRM) assessment and delivery. Since publication of the Pitt Review, it is apparent that SFRAs will provide the central store for data, information and consideration for all flood risk issues from all sources at a local level; and provide the linkage between Catchment Flood Management Plans (CFMPs), Shoreline Management Plans (SMPs), Regional Flood Risk Appraisals (RFRAs), SWMPs and appropriate sustainable land uses over a number of planning cycles.

SFRAs need to be fit for the future to help inform communities to meet the considerable FRM and climate change related challenges ahead.

1.3 Study Area

Manchester, Salford and Trafford are three of ten metropolitan districts that comprise the conurbation of Greater Manchester, a nationally important 'City Region' and the primary focus of future development within the North West. Manchester, Salford and Trafford have been allocated 59% of the total housing development for Greater Manchester and almost one quarter of the entire Region's total in the RSS. Figure 1-1 provides an overview of the study area.

Figure 1-1: Overview of the Manchester 'City Region'



The Government has also designated Greater Manchester as a New Growth Point, to help facilitate the accelerated delivery of additional housing – at least 20% above RSS annualised average rates - following the publishing of the Housing Green Paper in 2007. Housing is an integral element of a strategic approach to the long-term sustainable growth of the 'City Region', linked to employment growth and investment in transport and other infrastructure.

In line with the spatial focus of the RSS, the priority areas for housing and employment development within the three authorities are contained within the core of the conurbation, although some more peripheral areas also contain important development locations.

- Manchester's development is focused on 41 strategic sites within the Regional Centre and Inner Areas, as well as at Manchester Airport.
- Salford's development also has a strong focus on the Regional Centre and Inner Areas in Central Salford
- Trafford's development also has a strong focus on the Regional Centre/Inner Areas. There are 18 Strategic Locations and other development areas identified in the emerging Core Strategy.

The RSS allocates significant development to Manchester, Salford and Trafford, and whilst the three authorities can accommodate these allocations, there are some important issues that require careful assessment, including flood risk constraints.

The Rivers Irwell, Irk, Medlock, Corn Brook and numerous "hidden" watercourses meet in Manchester City Centre and drain into the Manchester Ship Canal, which also forms the boundary between Salford and Trafford councils.

2 Sources of Flood Risk

2.1 Introduction

This section assesses flood risk in Manchester, Salford and Trafford from all sources, now and in the future. It makes use of all the data and information collected during the consultation process that is relevant to a Level 1 SFRA. It presents the fluvial Flood Zones and assesses flood risk from other sources, providing information to support the Sequential Test.

The Greater Manchester sub-regional SFRA recognised the hydrological links between different local authorities and that flood risk cannot be addressed in isolation. Its findings highlighted the need for Manchester City, Salford City and Trafford Councils and the Environment Agency to work together on flooding problems, particularly where actions could exacerbate flooding in downstream communities. For example, managing the network of tributaries is complicated, but important, as they could also increase flooding problems in downstream areas.

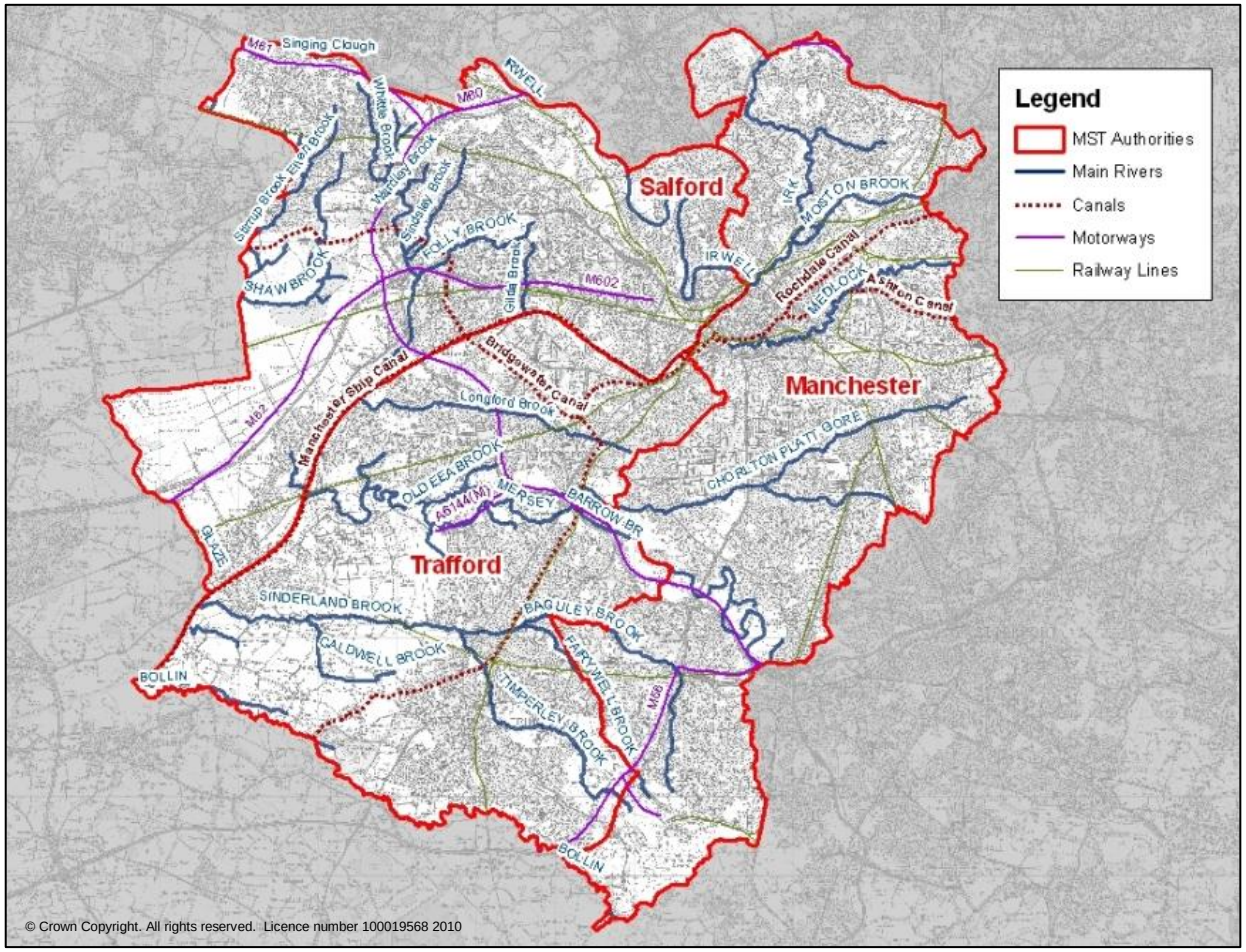
The sub-regional SFRA showed that within the Association of Greater Manchester Authorities (AGMA), Manchester, Trafford and Salford are potentially worst affected by development upstream. The councils upstream of Manchester, Salford and Trafford that could have a significant influence on reducing downstream flood risk can be split into groups based on catchments (AGMA members in bold):

- **Bolton, Bury, Oldham, Rochdale**, Blackburn with Darwen and Rossendale – Irwell catchment.
- **Wigan, Stockport, Tameside**, High Peak and Cheshire East – Mersey catchment.

The need for consistent regional development policies controlling runoff or development in floodplains within contributing districts is therefore crucial as this would have wider benefits within MST authorities.

Figure 2-1 presents an overview of the MST authorities showing the Main Rivers, canals, railway lines and motorways.

Figure 2-1: Overview Map



2.2 Fluvial Flood Risk

According to the Greater Manchester sub-regional SFRA, a significant source of flood risk across the region is from fluvial flooding. Fluvial flooding is flooding caused by high flows in rivers or streams exceeding the capacity of the river channel and spilling onto the floodplain, usually after a period of heavy rainfall.

Many of these rivers are large and form a focal point to the urban areas that surround them. Their presence through surrounding urban centres places a number of properties and people at risk on their floodplains. Flood risk on these watercourses is well documented and researched, with the majority of them modelled as part of Environment Agency flood mapping studies. Flood Zones produced by such studies provide the basis of the Environment Agency Flood Map.

However, due to the nature of the urban environment, a number of smaller watercourses have been culverted or diverted to make space for development. Some watercourses were in-filled or disconnected as the need for water supply to mills or other industries ceased. These watercourses are referred to as hidden or lost. The condition and standard of protection of these watercourses are unknown but they can provide a significant source of flood risk.

Manchester, Salford and Trafford contain over 250km of inland designated Main Rivers, which the Environment Agency has permissive powers to maintain. This does not include extensive additional lengths of Ordinary Watercourses or other privately owned streams or drains. These watercourses are the responsibility of the Local Authorities.

The majority of watercourses in the SFRA study area are within the River Irwell and Upper Mersey catchments. A list of the larger watercourses is provided in Table 2-1.

Table 2-1: Larger watercourses and their tributaries

Manchester	Salford	Trafford
River Irwell	**River Irwell** *Singing Clough* *Singleton Brook*	
Grey Irwell *River Irwell* *River Irk* *River Medlock*	**Grey Irwell** *River Irwell*	
River Irk *Boggart Hole Brook* *Boardman Brook* *Moston Brook*		
River Medlock		
Corn Brook		
	MSC *Grey Irwell* *Whittle Brook* *Linnyshaw Brook* *How Clough* *Sindsley Brook* *Folly Brook* *Salteye Brook (Worsley Brook)* *Gilda Brook*	**MSC** *Corn Brook* *Bent Lanes Brook (Longford Brook)* *River Mersey* *Red Brook (Sinderland Brook)*

Manchester	Salford	Trafford
	Kempnough Brook *Wardley Brook* *Platts Brook*	
River Mersey *Chorlton Platt Gore* *Cringle Black Brook* *Didsbury Inlet Channel* *Fielden Park Brook* *Gatley Brook*		**River Mersey** *Barrow Brook* *Old Eea Brook* *Carrs Ditch* *Stromford Brook* *Carrington Moss Brook* *Warburton Brook*
Sinderland Brook *Timperley Brook* *Fairywell Brook* *Baguley Brook*		**Sinderland Brook** *Caldwell Brook* *Timperley Brook* *Fairywell Brook* *Baguley Brook*
	Glaze Brook *Moss Brook* *Astley Brook* *Ellen Brook* *Shakerley Brook* *Wharton Brook* *Blue Box Ditch* *Shaw Brook* *Stirrup Brook* *Sniggley Brook* *Moss House Farm Brook* *Moss House Brook* *Whitehead Brook* *White Box Ditch*	
River Bollin		**River Bollin** *Old Bollin Brook* *Dunham Hall Brook*

The larger watercourses are discussed below. The Manchester Ship Canal is discussed in section 2.7.

2.2.1 River Irwell

The Irwell is one of the rivers that drove the industrial revolution, evidence of which remains today in the form of the large number of former textile mills along the river corridor. The river and its main tributaries are strongly connected with the urban areas through which they pass and have been largely responsible for their establishment, growth and expansion.

The River Irwell rises from Irwell Spring on Deerplay Moor and runs south in a course through the towns of Bacup, Rawtenstall, Ramsbottom, Bury, Radcliffe (where it is joined by the River Roch), Farnworth (where it is joined by the River Croal), Kearsley, Salford and Manchester. The River Irwell is not enmained between Cottenham Lane footbridge and Woden Street footbridge; the MSC starts at Woden Street footbridge but navigation rights may extend the length of the non main channel.

The river is known as the 'Grey Irwell' between the confluences of the Rivers Irk and Medlock. The Grey Irwell separates the city centres of Manchester and Salford. The Grey Irwell drains into the Manchester Ship Canal, which is the canalised lower section of the River Irwell.

The lower reaches of the Irwell have flooded many times in its history; the most well documented being the floods of 1946, 1954, 1980, and 2008.

The Environment Agency maintains the Kersal Flood Storage Reservoir and associated raised defences, which provides a 1 in 75 year standard of protection (SoP) to approximately 3,000 properties in the Kersal and Lower Broughton area of Salford. The area benefitting from this scheme is classified as an Area Benefiting from Defences (ABD).

2.2.2 River Irk

The River Irk rises near Shaw in Oldham. It flows south west passing through Royton and Middleton before flowing southwards towards Manchester City Centre, where it joins the River Irwell. The main tributaries of the Irk include Boggart Hole Brook and Moston Brook.

The Irk is relatively constrained to the channel until the floodplain widens between Crumpsall and Harpurhey in Manchester. Raised defences protect Vale Park Industrial Estate to a 1 in 50 year standard. The area benefitting from this scheme is classified as an Area Benefiting from Defences (ABD).

The floodplain extends again as the Irk reaches the city centre, upstream of Victoria Station.

2.2.3 River Medlock

The River Medlock rises in the hills to the east of Oldham. It flows through Oldham and Tameside before reaching Clayton in Manchester. The lower reaches of the river join the River Irwell in central Manchester and are extensively culverted.

The floodplain of the River Medlock is relatively natural through Clayton Vale. The Medlock is culverted under the City of Manchester Stadium and continues to meander in and out of culvert through the city centre. Flood Zone 2 and 3 is relatively wide through the urban landscape in the downstream reaches.

2.2.4 Corn Brook

Corn Brook drains the urban area south of the River Medlock. The brook is largely culverted and flows from Openshaw in a westerly direction, discharging into the Manchester Ship Canal at Pomona Docks. There are open lengths at the upstream reach (around 750m) and upstream of the siphon under the Bridgewater Canal (around 20m).

The culverted nature of the channel can result in significantly longer overland flow paths for floodwaters to return to the channel than would be expected in an open channel. This is reflected in the Flood Zones through Brunswick and Moss Side. The Flood Zones also highlight flooding upstream of the railway line in West Gorton.

2.2.5 River Mersey

The Mersey is formed from three tributaries: the Rivers Etherow, Goyt and Tame. The generally accepted start of the Mersey is at the confluence of the Tame and Goyt, in central Stockport. From Stockport it flows near Didsbury, Northenden, Stretford, Urmston and Flixton. At Carrington the Mersey flows into the Manchester Ship Canal (see section 2.7.2 for information on the MSC). The other main tributaries of the River Mersey are Chorlton Platt Gore, Barrow Brook, Stromford Brook, Carrington Moss Brook, Old Eea Brook and Carrs Ditch.

The Mersey meanders through Manchester and Trafford with an extensive floodplain reaching 1km wide in places.

There are two Flood Storage Areas along the Mersey at Didsbury and Sale Ees Water Park, which benefit downstream urban areas with up to a 1 in 50 year standard of protection.

2.2.6 Sinderland Brook and tributaries

Baguley Brook rises south of Wythenshaw and flows northwards. At its confluence with Brownley Brook north of Wythenshaw it turns due east and flows towards the MSC. At the confluence of Timperley Brook and Baguley Brook the watercourse becomes known as Sinderland Brook. The watercourse outfalls into the Manchester Ship Canal to the south of Partington in Trafford, where it is known as Red Brook,

The Environment Agency have recently completed a 2D modelling study for the Sinderland Brook and tributaries that shows there is the highest risk of flooding upstream of the Bridgewater Canal.

There has been historic flooding on the Sinderland Brook. A scheme has recently been implemented in Altrincham where a stretch of the Sinderland Brook has been deculverted and restored, which provides an element of flood storage.

2.2.7 Glaze Brook

Glaze Brook rises to the south east of Wigan and outfalls to the Manchester Ship Canal at Cadishead in Salford. Flood risk arises after prolonged rainfall when water overtops watercourse banks or following intense and heavy rainfall when local drainage capacity is exceeded. Localised flooding is associated with the catchments of Ellen Brook and Shaw Brook in Boothstown in Salford.

2.2.8 River Bollin

The River Bollin has a largely rural catchment and rises in the Pennines. It forms the boundary between Cheshire East and Trafford Councils. There is low flood risk to Manchester and Trafford from the River Bollin.

2.2.9 "Hidden" and Culverted Watercourses

There are other watercourses within the Greater Manchester area which are not captured on Environment Agency maps. Many modified small streams, brooks and culverts are now hidden below ground and their condition is deteriorating; they become blocked with debris and are the cause of much localised flooding following heavy rainfall. Some of these have been mapped by Ashworth in 1987 and are referred to as the 'hidden rivers of Manchester'.

Due to the heavily urbanised nature of Greater Manchester, only a few of the watercourses are in their natural form. Many of the main river channels have been straightened and canalised to accelerate the flow of water and have been culverted over significant lengths. Many of the channels and culverts have a limited hydraulic capacity and are prone to blockages which can lead to flooding. The blockages are caused by silt deposition from the rural upstream sections of the catchments, vegetation falling into the river or through fly tipping.

The Greater Manchester Sub-Regional SFRA identified and mapped culverted watercourses using National Flood and Coastal Defence Database (NFCDD) and hidden watercourses with aid from Manchester University. An overview of the magnitude of the culverted channels identified in this report is provided in Table 2.2.

The majority of hidden watercourses are located in the Manchester district. The Environment Agency is currently preparing the South Manchester Flood Risk Management Strategy which is likely to investigate this risk further.

Table 2-2: Culverted Channels[3]

Authority	Length of Culverted Channel (km) as identified in the Greater Manchester Sub-Regional SFRA
Manchester	19.64
Salford	10.65
Trafford	13.09

Further information on culverted channels in Salford is available through the Highway Strategy Group.

2.3 Flooding from Land

The Environment Agency has recently produced a national map of Areas Susceptible to Surface Water Flooding (ASSWF), which identifies areas susceptible to surface water flooding during an extreme rainfall event (1 in 200 year). This is valuable as it provides an indication of the likelihood of surface water flooding, separated into areas at less, intermediate or high susceptibility.

Urban drainage modelling is a complex field, varying from simple topographic analysis, to routing of water over an elevation model (which is how the national ASSWF map has been produced), to network models of the sewer system linked to overland routing, to fully integrated river, sewer and overland models. SFRAs require a strategic assessment of the likelihood of surface water flooding for which overland routing is suitable and appropriate.

As part of the Level 2 SFRA, refined surface water maps for Manchester, Salford and Trafford were produced using overland routing modelling. These maps used more detailed topographic data and incorporated the presence of buildings and roads into the modelling and are hence considered to supersede the ASSWF maps. As per the national map this provides an indication of the likelihood of surface water flooding, separated into areas at less, intermediate or high susceptibility.

The Level 2 SFRA surface water flood map and flood risk assessment indicates that the following wards are at highest risk of surface water flooding:

Manchester

- City Centre
- Levenshulme
- Didsbury East
- Northenden
- Charlestown

Salford

- Pendlebury
- Swinton North
- Weaste and Seedley
- Eccles
- Little Hulton

Trafford, risk is lowest here with the following wards at the most risk:

- Bowdon
- Broadheath
- Gorse Hill

[3] AGMA (2008) Greater Manchester Sub-Regional SFRA – lengths calculated using NFCDD

2.4 Flooding from Sewers

The information available from United Utilities (UU) included DG5 records, location of drainage areas and sewers records. United Utilities sewer flood risk data was not available in the timescales for this project. The Local Authorities should continue to work in partnership with United Utilities over the availability and use of sewer flood risk data. United Utilities flood risk data should be used in further work following on from this SFRA, including Surface Water Management Plan work.

Whilst the DG5 register can give an idea of those areas with limited drainage capacity, it must be acknowledged that it is a register of properties that have already been flooded due to exceedance or the blockage or failure of sewer systems, not properties at risk of flooding. In addition to this, sewer flooding problems may have been investigated and resolved since the register was compiled. For these reasons the DG5 register alone has limited usefulness in predicting future flooding locations.

Surface water and sewer flooding is often interconnected. For example, high water levels in receiving watercourses and the Manchester Ship Canal could prevent the free discharge of surface water or combined sewer overflows through the sewer network. This could cause the sewer network to back up and surcharge, causing flooding.

Information from the MST authorities and the AGMA Sub-Regional SFRA indicates that sewer flooding problems are present throughout the large urban areas.

In Manchester, sewer and drainage problems have been identified during rainfall events, with issues in Northenden, Didsbury, Fallowfield and in the city centre.

Sewer flooding is known to have occurred in Salford where up to 1,000 properties are at risk of localised flooding from surface water, sewers and smaller watercourses. Flood risk data has been provided by Salford City Council which identifies sewer flooding hotspots in Walkden, Worsley, Peel Green, Swinton and Boothstown.

In Trafford sewer flooding is known to be a problem in Flixton, Altrincham and Sale.

2.5 Flooding from Groundwater

Groundwater flooding is caused by the natural emergence at the ground surface, of water originating from underlying permeable sediments or rocks (aquifers). The groundwater may emerge as one or more point discharges (springs) or as diffuse discharge/seepage over an extended area. Groundwater flooding tends to be more persistent than other sources of flooding, typically lasting for weeks or months rather than for hours or days.

Groundwater flooding does not generally pose a significant risk to life due to the slow rate at which the water level rises; however, it can cause significant damage to property, especially in urban areas.

Refer to Map 2.1 for more information on the pattern of potential groundwater flooding.

2.5.1 Historical Records of Groundwater Flooding

According to Greater Manchester sub-regional SFRA there are no known reports of groundwater flooding in the Manchester, Trafford and Salford authorities. However, a number of areas within Trafford appear to suffer from a high water table or standing water (Map 2.1):

- Stamford Brook Development.
- South of Edge Lane, Stretford.
- Areas of Timperley in the vicinity of Heyes Lane and Fairywell Brook.

In parts of Salford there are problems with waterlogged ground and cellars in Winton (off the B5211 Worsley Road near Worsley Brook) that are known to flood. Waterlogging of the ground may be due to the presence of slowly permeable soil rather than a shallow water table. However, the flooding of basements close to a watercourse is likely to

represent alluvial groundwater flooding. Alluvial deposits are those close to a watercourse that have been laid down by the river over time.

Past studies have identified 15 sites in England where groundwater levels were known to be rising[4]. One of these was Trafford Park in Manchester, where groundwater levels rose by about 15m between 1970 and 1986. This rise was due to a reduction in abstraction from the Permo-Triassic sandstone aquifer. The Environment Agency (2007) identified the area around Trafford Park and Stretford as being potentially at risk of groundwater rebound.

Reduced abstraction has also led to groundwater rebound in central Manchester, although levels have now stabilised[5].

Minewater rebound

The AGMA Sub-Regional SFRA highlighted minewater rebound as a potential issue for all three districts. The Coal Authority is responsible for monitoring rising groundwater levels resulting from the cessation of mine dewatering. The Coal Authority considers minewater levels in Manchester, Salford and Trafford to have recovered or almost recovered. Some areas are likely to experience a slight rebound, but the effects of this will be minimal.

Mechanisms

Table 2-3 lists the various mechanisms of groundwater flooding and assesses the likelihood of occurrence. The mechanisms most likely to be significant in the area are alluvial groundwater flooding and groundwater rebound. The one reported case of groundwater flooding (flooding of basements in Winton, Salford) appears to be due to alluvial groundwater flooding.

Table 2-3: Groundwater Flood Risk Assessment for Manchester, Trafford and Salford

Mechanism	Likelihood	Comments
1. Prolonged heavy rainfall in an area with a shallow water table.	Low	This mechanism is mainly associated with chalk aquifers but none are present in the Manchester/Trafford/ Salford area. The aquifers in the study area generally have high storage potential and so have relatively small fluctuations in groundwater level. However, there is still the potential for localised groundwater flooding (e.g. of basements) in areas with a very shallow water table. See Map 2.1.
2. Alluvial groundwater flooding due to high river levels.	Moderate	The risk is greatest where permeable alluvial sediments are connected to a major river, e.g. the Mersey. The one reported instance of basement flooding occurs close to a watercourse (Worsley Brook, Salford). See Map 2.1
3. Groundwater rebound due to decreased abstraction.	Low to moderate	This is most significant in the Trafford Park - Stretford area. See Map 2.1
4. Minewater rebound	Low	Water levels are mostly recovered.

[4] Brassington, F. C., 1990. Rising groundwater levels in the United Kingdom. Proceedings of the Institution of Civil Engineers, vol. 88, part 1, p.1037-1057.
[5] Jacobs, 2004. Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS 23). Final Report produced for Defra, 2 Volumes, May 2004.

Mechanism	Likelihood	Comments
due to cessation of mine dewatering.		
5. Ground subsidence.	Low	The area has been undermined, so there is the potential for some subsidence - for example, due to the collapse of supporting pillars. However, it is likely that most subsidence has already occurred.
6. Leaky drains, sewers and water supply mains.	Low	Possibly of local significance.
7. Artificial obstructions.	Low	Possibly of local significance. This mechanism is only likely to be important where there is a very thin shallow aquifer and very dense development.
8. Faulty borehole constructions.	Low	Restricted to areas where boreholes penetrate confined bedrock aquifers.
9. Seepage into tunnels and unlined trenches.	Low	Possibly of local significance.
10. Infiltration drainage raising the water table.	Low	Possibly of local significance. This mechanism is only likely to be important in areas of permeable ground with a shallow water table. The part of Trafford identified by Scott Wilson (2008a, b) as being suitable for infiltration-based Sustainable Drainage Systems includes areas where the water table is likely to be near the surface (as suggested by the GEM and by information about Timperley supplied by Trafford Council).

2.6 Flooding from Reservoirs

The Environment Agency did not provide a copy of the Reservoir Register, which identifies those reservoirs under the Reservoirs Act, due to "implications for national security".

However, discussions with councils and a review of OS mapping shows there a number of reservoirs within or adjacent to the Manchester City, Salford City and Trafford Council areas. Table 2-4 identifies the reservoirs and the main urban area at risk immediately downstream of them. This is not an exhaustive list of upstream reservoirs but is included to highlight the key reservoirs.

Table 2-4: Key Reservoirs

Reservoir Name	Local Authority	Downstream Urban Area
Blackleach	Salford	Walkden, Linnyshaw, Worsley
Whittle Brook	Salford	Walkden
Old Warke Dam	Salford	Alder Forest
Dunham Park (covered)	Trafford	Parklands, Hale
Sale Ees (Flood Storage Reservoir)	Trafford	Sale
Heaton Park	Manchester	Whitefield, Crumpsall,

Reservoir Name	Local Authority	Downstream Urban Area
		Harpurhey
Heaton Park Boating Lake	Manchester	Crumpsall
Didsbury (Flood Storage Reservoir)	Manchester	Northenden, Didsbury
Gorton Lower and Upper (Debdale)	Manchester	Gorton, Rusholme, Fallowfield, Whalley Range
Audenshaw	Tameside	Gorton, Rusholme, Levenshulme, Fallowfield, Whalley Range
Alkrington Hall	Rochdale	Higher Blackley, Alkrington
Clarkes Hill (covered)	Bury, Manchester	Whitefield

2.7 Flooding from Canals

The following canals lie within Manchester, Salford and Trafford:

- The Rochdale Canal, passing through the north of the Manchester City Council area.
- The Ashton Canal, passing through the east of the Manchester City Council area.
- The Bridgewater Canal, passing through each Council area.
- The Manchester Ship Canal, which forms the boundary between Salford City and Trafford Councils.
- The recently reopened length of Manchester, Bolton and Bury Canal in Salford City Council area.

There are two types of canal:

1. **Broad Canal**. The Bridgewater, Ashton, Manchester, Bury and Bolton and Rochdale Canals are broad canals that were initially built to serve the growing industrial centres of the North West during the Industrial Revolution. These are fairly shallow canals that have raised embankments in places and mainly used today for tourism, carrying narrow boats and other small boats. The Ashton, Manchester, Bury and Bolton and Rochdale Canals are managed by British Waterways. The Bridgewater Canal is owned and operated by the Manchester Ship Canal Company in conjunction with the Bridgewater Canal Trust[6].
2. **Ship Canal**. The Manchester Ship Canal was built by canalising sections of the lower River Irwell and River Mersey in the late nineteenth century to allow large ships to dock in Manchester city centre. The MSC is managed by the Manchester Ship Canal Company and water levels in the canal are carefully monitored and controlled by a system of sluices. Although named as a canal, the MSC is a canalised watercourse and hence its flooding mechanisms have more in common with a watercourse than a typical canal.

Both British Waterways and the Manchester Ship Canal Company are key stakeholders in the management of canals and have been consulted as part of the SFRA process.

The interaction between these canals and the main rivers, particularly in Manchester City Centre, are integral to the understanding of flood risk. Figure 2-2 presents a schematic showing this interaction.

[6] **www.bridgewatercanal.co.uk** [Access date March 2010]

2.7.1 Risks from Broad Canals

These canals do not pose a direct flood risk as they are controlled water bodies with regulated flows. However, there are residual risks associated with lower probability events such as breaching of embankments. The residual risk associated with canals is unknown as it depends on a number of factors including: the source of water into the canal, materials used within the canal embankments and the condition of those embankments. The risk is limited due to continued maintenance by British Waterways (Ashton, Manchester, Bury and Bolton and Rochdale Canals) and the Manchester Ship Canal Company (Bridgewater Canal) and the controlled volume of water within an impounded length. If an event occurs the consequences can be quite high, especially if people or properties are situated directly below the breached length.

The potential residual risks from each of the Broad Canals are discussed below.

Risks on the Rochdale Canal

The main flood hazards on the Rochdale Canal are perceived to arise from overtopping and/or breaching. Specific issues include:

- a potentially high inflow to the canal with flow towards Manchester during flood conditions which exceeds the canal capacity at Manchester,
- overtopping and possible failure of the raised embankment at Miles Platting.

Risks on the Ashton Canal

The main flood hazards on the Ashton Canal are perceived to arise from overtopping and/or breaching. Specific issues include:

- a potentially high inflow to the canal with flow towards Manchester during flood conditions which exceeds the canal capacity at Manchester,
- possible blockage of the bywash at Ancoats in flood conditions and a consequent overtopping of the canal banks.

Risks on the Bridgewater Canal

The main flood risks on the Bridgewater Canal are perceived to arise from overtopping and/or breaching. Specific issues include:

- a potentially high inflow to the Bridgewater Canal at Worsley from overtopping of Old Warke Dam and M60 surface water discharges during flood conditions.
- a potentially high inflow to the Bridgewater Canal from the Rochdale Canal during flood conditions,
- a potentially high inflow to the Bridgewater Canal from the MSC around Pomona Island during flood conditions,
- a potentially high inflow to the Bridgewater Canal from the River Medlock or Corn Brook during flood conditions,
- a potentially high inflow in the Bridgewater Canal towards Manchester caused by a net inflow over the 60km pound to the west of Manchester in peak flood conditions,
- westerly winds during flood conditions which would increase the canal water levels at Manchester (similar to the 1987 event),
- a total combined inflow which exceeds the canal capacity leading to a breach of a raised section into development areas with lower land levels (similar to the Dunham Massey failure, 1971).

Risks on the Manchester, Bury and Bolton Canal

The Manchester, Bury and Bolton canal is derelict and infilled throughout much of Salford. There are plans by British Waterways to restore the canal by 2020 and the path of the canal is protected from development. However the exact location, capacity and structures to restore the canal are unknown. Hence flood risk from this canal has not been considered in the SFRA, but will need to be in the future if and when canal restoration is taken forward.

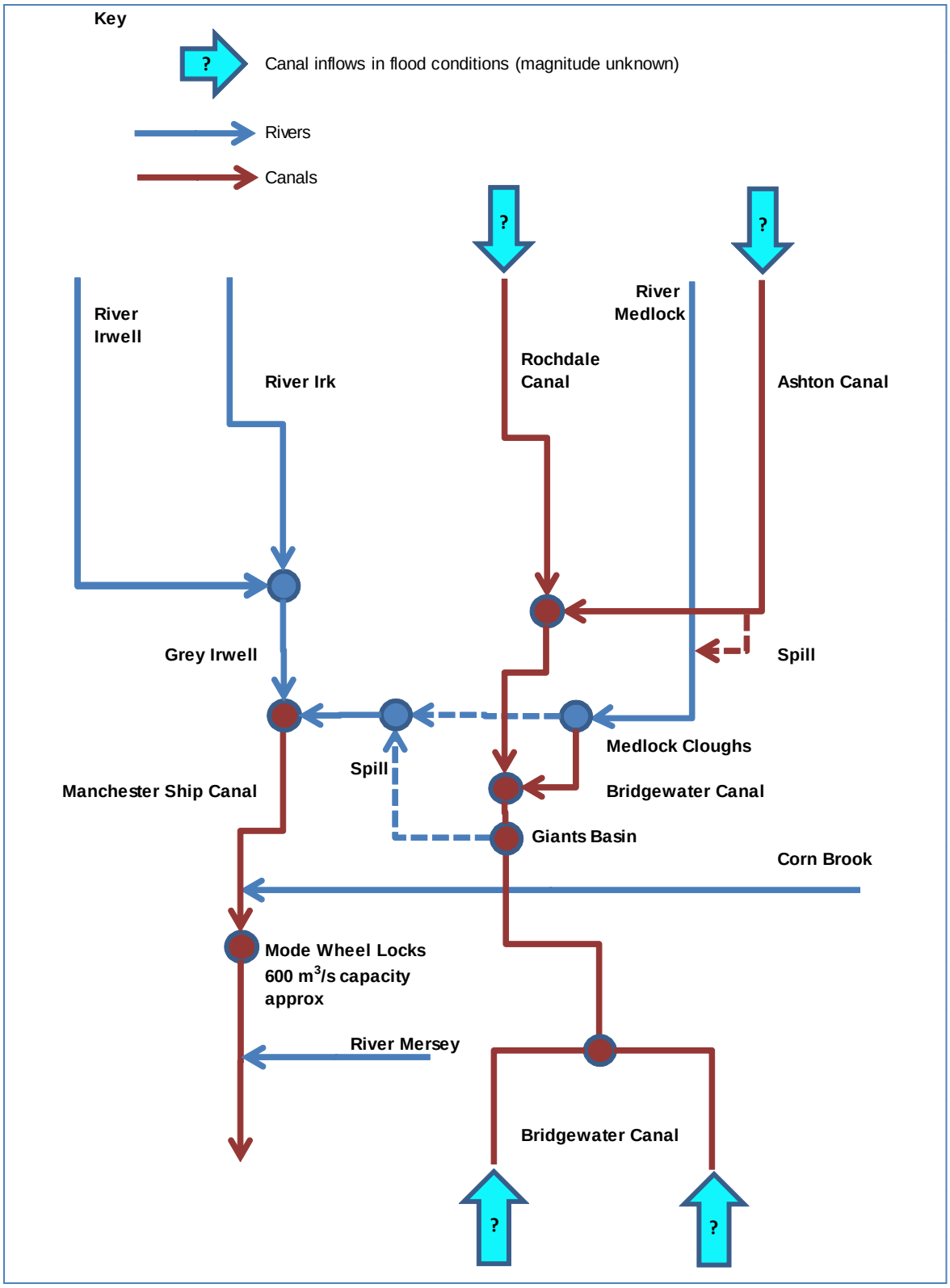
2.7.2 Risks on the Manchester Ship Canal

The Manchester Ship Canal (MSC) in the study area is fed by the rivers Grey Irwell, Medlock, Mersey and Bollin and the Gilda Brook, Worsley (Salteye) Brook, Longford (Bent Lanes) Brook, Platts Brook, Glaze Brook, Sinderland Brook, Warburton Park Brook and Warburton Brook. The Manchester Ship Canal drains the catchments of the River Irwell and Mersey and hence in a flood event could receive significant inflows from these systems, potentially causing overtopping.

However, the canal has a large capacity in Greater Manchester. Water levels in the canal are carefully monitored and controlled by a system of sluices. At Mode Wheel Locks the canal has a capacity of approximately 600m³/s. If water levels rise at Manchester city centre the sluices are opened to allow water to pass down the system.

There are no raised flood defences along the MSC and therefore no records of breaching of raised sections. The tow path at Pomona Docks has been known to flood. Part of the Manchester surface water drainage system drains into the canal and inflows may be significant in storm conditions.

Figure 2-2: Schematic Showing Interaction between Watercourses and Canals



2.8 Historical Flooding

Records of past flooding are useful for looking at the sources, seasonality, frequency and intensity of flooding. Table 2-5 provides an overview of significant flood events in Manchester, Salford and Trafford. Historical records are often anecdotal and incomplete and it can be difficult to determine accurately the frequency and consequences of events, but they are useful for providing background information. More recent gauged records and registers of flooded properties are valuable for estimating flood frequency and severity at different locations.

Also, flood risk can change over time because of natural variations in climate, changes in land use and the changes in flood risk management activity. Over the last few hundred years, developments have been increasingly built on the floodplain and there is some evidence that farming practices that promote rapid run-off of rainwater into rivers have become widespread. Due to these changes, flood risk might be higher today than it was in the past, although any flood risk management work that is undertaken helps to reduce this.

The Environment Agency also maintains a National Historic Flood Map which records known flood extents (referred to as Flood Event Outlines). Locations shown as being affected in the past are listed in Table 2-5.

Table 2-5: Historical Flood Events

Date	Source	Description	Data source
2008	MSC	Overtopping of tow path	SFRA Steering Group
2008	River Irwell	Littleton Road Flood Basin operated. Flooding of low lying land - no reports of properties flooded	Salford City Council
2007	Ashton Canal	Flooding reported at Ancoats	EA Flood Event Outline
2006	Surface water	Roads and 20 houses in Heywood flooded	Irwell CFMP
2004	MSC	Overtopping of MSC flooded 16 properties at Barton Upon Irwell and roads in Peel Green	Salford City Council
2004	Worsley Brook	Flooding of roads and properties in Alder Forest	EA Flood Event Outline Salford City Council
2004	Sewers	Altrincham, Flixton, Sale, Hale. Sewer flooding following intense rainfall. Flooded gardens, highways and properties	Trafford Council
2004	Chorlton Brook	Flooded Halls of Residence, Manchester University, Fallowfield	AGMA Sub-regional SFRA
2002	Medlock	Analysis of London Road Gauging Station readings indicate the event return period to be approximately 80 years	River Medlock SFRM, 2009
2002	Irwell	11 properties flooded in Irwell Vale	Irwell CFMP

Date	Source	Description	Data source
2001	Medlock / Bridgewater Canal	Overtopping of canal at Castlefield hotel area	Manchester Evening News
2000	Irk	Harpurhey	EA Flood Event Outline
2000	Bridgewater Canal	Raglan Road, Sale	EA Flood Event Outline
2000	Mersey	Intense rainfall led to flash flooding of doctor's surgery, Sale	AGMA Sub-regional SFRA
1999	Whittle Brook	12 residential properties flooded, Linnyshaw	EA Flood Event Outline Salford City Council
1998	Irwell	Lower Kersal and Broughton	EA Flood Event Outline
1998	Mersey	Flooding to properties in Didsbury, Northenden and Carrington	Upper Mersey CFMP and EA Flood Event Data
1991	Unknown	Flooding in Castlefield, Manchester City Centre, Great Lever, Ramsbottom, Radcliffe, Marple Bridge, Didsbury, Hollingworth, Stretford and Bury	Manchester Evening News
1991	Medlock	Flooding in Manchester City Centre	River Medlock SFRM, 2009
1981	Chorlton, Baguley, Sinderland and Timperley Brook	Over 280 properties flooded in Fallowfield, Withington, Gorton, Sale, and Altrincham	Upper Mersey CFMP
1980	Irwell	Flats flooded, Lower Kersal and Broughton	Irwell CFMP
1978, 1979, 1980 and 1983	Medlock	Flooding likely to be related to blockages and debris build up	River Medlock SFRM, 2009
1978	Mersey	Didsbury	EA Flood Event Outline
1971	Bridgewater Canal	Breach at Dunham Massey, near the Bollin aqueduct	British Waterways
1965	Mersey	Mersey defences breach, Stockport	Upper Mersey CFMP
1965	Sewer	Sewer burst and surface water flooding to properties in Northenden and Didsbury	BHS Database
1958	Surface water and sewer	Flooded rail station. Wilbraham (Fallowfield), Ardwick and Fallowfield	BHS Database
1954	Irwell	600 properties	Irwell CFMP

Date	Source	Description	Data source
1947	Surface water and sewer	Flooded rail station and line. Wilbraham (Fallowfield)	BHS Database
1946	Irwell	5,300 properties and 243ha flooded	Irwell CFMP
1923	Mersey	Sale Priory flooded up to 11ft deep	BHS Database
1911	Mersey, surface water, sewage	Flooded sewage works affecting Moss Side, Withington and Fallowfield	BHS Database
1890	Mersey	Flood damage to properties in Northenden and Didsbury	BHS Database
1872	Medlock, Mersey, Irk, Bridgewater Canal	Extensive flooding to properties in lower lying areas along: • Mersey (Northenden, Didsbury) • Medlock (North Manchester) Medlock overtopping into Bridgewater Canal. Barges in canal lifted out	BHS Database
1866	Medlock, Irwell	Major flood damage	BHS Database
1852, 1856, 1857, 1860	Medlock	Flooding with some damages	BHS Database
1833	Medlock	Flooding from the River Medlock	BHS Database
1799	Irk	Flooding to lower Irk valley. Roads and properties in North Manchester flooded	BHS Database

2.9 Flood Defences

Refer to Map 1.1 for the location of the key Flood Risk Management (FRM) assets across Manchester, Salford and Trafford.

Flood defence on the Manchester Ship Canal is provided by the operation of water control structures (sluices) on the Manchester Ship Canal within the study area at:

- Mode Wheel Locks
- Barton Locks
- Irlam Locks

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

The Environment Agency's National Flooding and Coastal Defence Database (NFCDD) has been supplied and provides information of existing defences in the area, as well as categorising them by type and providing information on who owns and maintains them.

Areas Benefiting from Defences (ABDs) have also been provided. ABDs are those areas which benefit from formal flood defences in the event of flooding from rivers with a 1% chance in any given year or from the sea with a 0.5% chance in any given year. If the defences were not there, these areas would be subjected to increased flood risk.

The condition of existing flood defences and whether they will continue to be maintained and/or improved in the future is an issue that needs to be considered as part of the risk based sequential approach and in the light of this, whether proposed land allocations are appropriate and sustainable. In addition, detailed FRAs will need to explore the condition of defences thoroughly, especially where these defences are informal and contain a wide variation of condition grades.

It is important to be mindful of the investment and maintenance plan for local assets and the wider FRM approach. The long term FRM policy and strategy is identified in the River Irwell CFMP, Upper Mersey CFMP and the emerging Environment Agency strategy documents. In general, the CFMP policies for the catchments within the MST authorities tend to be to '*take action to sustain the current level of flood risk into the future'* and to *'take action to reduce the flood risk'*. However, in the Upper Mersey and Kearsley to Kersal Policy Units the preferred policy is to *'take action with others to store water or manage run-off'.*

Whilst the Environment Agency is responsible for managing defences along main watercourses to deliver these policy objectives, the MST authorities have responsibility within the wider catchment at upstream locations. The future scope for existing defences to be continually upgraded to manage flood risk alone is limited and this SFRA has highlighted the need for a coherent catchment wide approach to flood risk management.

The Environment Agency strategy documents will form one aspect of this approach and will outline the investment schedule to manage the flood risk from main watercourses, Surface Water Management Plans will form another.

Local authorities should work closely with the Environment Agency through their emerging strategy work following on from the River Irwell and Upper Mersey CFMPs and within Surface Water Management Plan partnerships to explore opportunities to reduce flood risk and deliver regeneration.

2.10 Flood Warning Areas

Table 2-6 shows the Flood Warning Areas (FWA) within Manchester, Salford and Trafford. The Environment Agency issues flood warnings based on 4 levels of risk:

- **Flood Watch** – Flooding of low-lying land and roads is expected. Be aware, be prepared, watch out.
- **Flood Warning** – Flooding of homes and businesses is expected. Act now!
- **Severe Flood Warning** – Severe flooding is expected. There is extreme danger to life and property. Act now!
- **All Clear** – Flood Watches or Warnings are no longer in force in this area.

Table 2-6: Flood Warning Areas

Flood Warning Code	Area	Type of Warning
GM2	River Irwell at Salford, Lower Irwell	Area A - Flood Warning Area B and C - Severe Flood Warning
GM3	River Mersey at Chorlton Water Park	Flood Warning
GM6	River Mersey at Didsbury	Area A - Flood Warning Area B - Severe Flood Warning
GM8	River Mersey at Flixton	Flood Warning
GM10	River Mersey at West Didsbury / Northenden	Flood Warning
GM12	Cringle Brook, Withington	Severe Flood Warning
GM13	Cringle Brook, Fallowfield	Severe Flood Warning
GM14	Gore Brook, Birch	Flood Warning
GM15	Chorlton and Platt Brooks in the Whalley Range and Fallowfield	Severe Flood Warning
GM16	Chorlton, Platt and Gore Brooks	Severe Flood Warning
GM17	Gore Brook, Gorton	Severe Flood Warning
GM18	Baguley Brook at Brooklands and Baguley	Severe Flood Warning
GM19	River Medlock, Manchester City Centre	Severe Flood Warning
GM20	Timperley Brook at Altrincham	Severe Flood Warning
GM26	River Irwell at Kearsley	Severe Flood Warning

2.11 Effects of Climate Change

Climate change projections (UKCIP02 scenarios) suggest that winters will become wetter over the whole of England, by as much as 20% by the 2050s. A shift in the seasonal pattern of rainfall is also expected, with summers and autumn becoming much drier than at present. Snowfall amounts will decrease significantly throughout the UK, but the number of "rain-days" and the average intensity of rainfall are expected to increase.

Rainfall intensity and the increase in the number of rain-days could have significant implications for surface water flooding and should be considered when designing drainage systems for new developments.

Table B.2 of PPS25 provides recommended national precautionary sensitivity ranges for peak rainfall intensity and peak river flows that have been used in the SFRA:

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		

A new set of climate change projections (UKIP09) have been recently published; however, there is currently no Defra guidance on how to use the projections within flood and coastal flood risk management, including sensitivity ranges for flood risk modelling.

3 Level 1 SFRA Mapping

3.1 Introduction

The SFRA has provided a broad overview of flood risk from all sources as described in the previous chapter. This broad assessment is assisted greatly by the use of Strategic Flood Risk Maps providing information on flood risk factors that need to be taken into account.

The sets of Strategic Flood Risk Maps provided as part of the MST Level 1 SFRA are shown in Table 3-1. The maps incorporate the results of the Level 2 SFRA work undertaken as part of this project where applicable. This affects the Fluvial Extents and Depth maps and the Surface Water Flooding Maps.

A summary providing details of all mapping methodologies for the Level 1 and Level 2 SFRA and background information on each map is provided in the Maps Index.

Table 3-1: Mapping relevant to the Level 1 SFRA

Flood Risk Management	Map FL_1.1
Flood Zones	Map FL_1.2
Fluvial Extents	Map FL_1.3 & Map FL_1.4
Fluvial Depth	Map 1.5
Groundwater Flooding	Map GW_2.1
Reservoir Screening	Map MM_3.1
Surface Water Flooding	Map SS_4.1 & Map SS_4.2

4 Site Specific Allocations

4.1 Introduction

The suitability of development allocations needs to be assessed based on the Sequential Test and Exception Test included in PPS25. The Sequential Test is based on development allocations, their situation in regards to flood risk, that level of risk and also the development's vulnerability to that risk. When allocating or approving land for development in flood risk areas, those responsible for making development decisions are expected to demonstrate that there are no suitable alternative development sites located in lower flood risk areas (i.e. the sequential approach). Exceptionally, proposed development sites can be taken forward, if the conditions of the Exception Test are fulfilled.

This Level 1 SFRA aids the application of the Sequential Test and, where needed, the Level 2 SFRA will provide an additional layer of information to complete the Sequential Test.

The following section provides summary tables of sites assessed in the MST Level 1 SFRA. One of the main outputs of this assessment is the Sequential Test Spreadsheet discussed below.

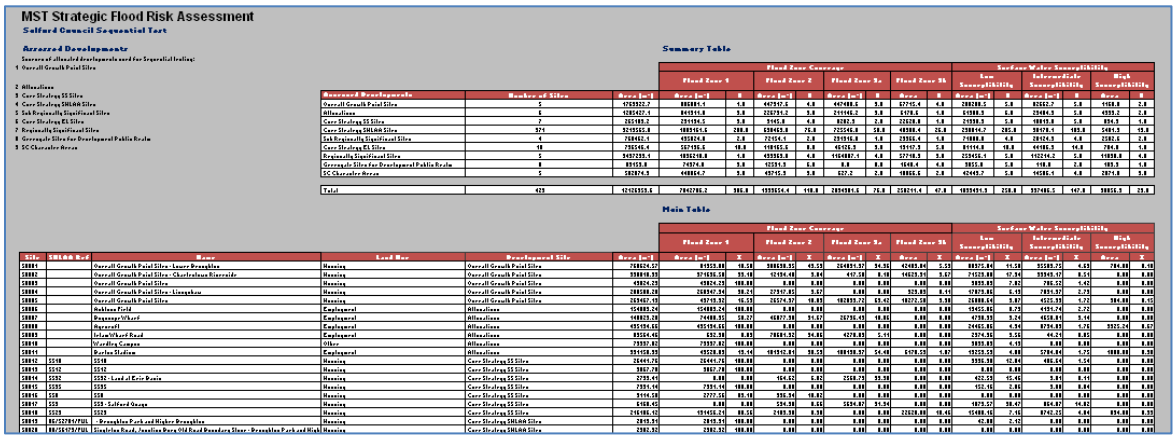
4.2 Development Site Sequential Test

A Sequential Test Excel spreadsheet has been produced including all of the proposed allocations provided by the MST authorities assessed against PPS25 Flood Zones. The Flood Zones (v13.5) were released in September 2009 and have been used for this project. In addition to these the Flood Zones for the Manchester Ship Canal and Grey Irwell that is understood will be in the March 2010 Flood Map update and the latest Sinderland Brook Flood Zones that is understood will be in the June 2010 Flood Map update have been used in the SFRA.

As an extra layer of information, the surface water vulnerability zones from the Level 2 SFRA refined surface water modelling have been included on the Sequential Test spreadsheet.

Each LPA should use this information when applying the Sequential Test. As part of the guidance they should also use information on flood risk from other sources in their allocation of development.

Figure 4-1: Screenshot of Sequential Test Spreadsheet



Tables 4-1 to 4-3 (from the Sequential Test spreadsheet) provide a summary of sites investigated which are at risk of fluvial flooding. The Flood Zones do not include overlapping zones, for example, Flood Zone 2 is just the area outside of Flood Zone 3, however where sites extend over multiple flood zones these will be counted as being in both Flood Zones.

Table 4-1 shows:

- That over 90% of the total area proposed for development in Manchester is at low probability of flooding and within Flood Zone 1.
- Approximately 6% of the area of Capacity Sites (housing) are at high risk of flooding (within Flood Zone 3).
- Only 0.9% of the area of development sites are within Flood Zone 3b.

Table 4-1: Summary of Manchester Development Sites at Risk of Fluvial Flooding

Development Site			Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
Site Name	**Total Area (km²)**	**No. Sites**	**Area (km²)**	**No.**	**Area (km²)**	**No.**	**Area (km²)**	**No.**
Strategic Employment Site	116.45	7	5.24	4	1.88	3	0.43	5
Strategic Housing Site	51.42	18	2.69	7	1.84	6	0.99	6
District Centres	16.44	15	0.18	3	0.01	2	0.00	2
Capacity/SHLAA Sites	85.80	767	4.09	79	2.26	45	0.89	28
Total	**270.09**	**807**	**12.21**	**93**	**6.00**	**56**	**2.32**	**41**

Table 4-2 shows:

- That 58% of the total area proposed for development in Salford is at low probability of flooding and within Flood Zone 1.
- Approximately 18% of all sites are at high risk of flooding (within Flood Zone 3).
- Three of the Regionally Significant Sites are at a very high risk of flooding in Flood Zone 3b.

Table 4-2: Summary of Salford Development Sites at Risk of Fluvial Flooding

Development Site			Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
Site Name	Total Area (km²)	No. Sites	Area (km²)	No.	Area (km²)	No.	Area (km²)	No.
Overall Growth Point Sites	1.77	5	0.45	4	0.45	3	0.07	4
Allocations	1.29	6	0.23	3	0.21	3	0.01	1
Core Strategy SS Sites	0.27	7	0.00	4	0.01	2	0.02	1
Core Strategy SHLAA Sites	3.21	371	0.64	76	0.73	58	0.04	26
Sub Regionally Significant Sites	0.77	4	0.07	2	0.23	1	0.03	1
Core Strategy EL Sites	0.74	18	0.11	8	0.05	3	0.01	5
Regionally Significant Sites	3.50	5	0.44	4	1.16	4	0.06	3
Total	**12.13**	**429**	**2.00**	**110**	**2.83**	**76**	**0.25**	**47**

Note - S1047 Media City Regionally Significant Site includes large canal basins which are designated as within Flood Zone 3

Table 4-3 shows:

- That over 80% of the total area proposed for development in Trafford is at low probability of flooding and within Flood Zone 1.
- Nine of the Strategic Locations and other development areas are at high risk of flooding (Flood Zone 3).
- Only 1% of the area of development sites is within Flood Zone 3b.

Table 4-3: Summary of Trafford Development Sites at Risk of Fluvial Flooding

Development Site			Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
Site Name	Total Area (km²)	No. Sites	Area (km²)	No.	Area (km²)	No.	Area (km²)	No.
Strategic Locations and other development areas	17.93	18	1.98	11	1.20	9	0.19	4
SHLAA Sites	2.60	461	0.20	21	0.49	18	0.01	3
Total	**20.53**	**479**	**2.19**	**32**	**1.68**	**27**	**0.21**	**7**

Tables 4-4 to 4-6 (from the Sequential Test spreadsheet) provide a summary of sites investigated which are at risk of surface water flooding. The susceptibility zones do not include overlapping areas, for example, the more susceptible zone is not included in the intermediate zone, and the intermediate zones is not included in the less susceptible zone. However, where sites extend over multiple susceptibility zones these will be counted as being in more than one susceptibility zone.

Between 8% and 11% of the area of development sites across the councils are 'less susceptible' to surface water flooding with typical depths of >0.1m. Only a small proportion (<1%) of the area of development sites across the councils are 'more susceptible' to surface water flooding with typical depths of >1m.

Table 4-4: Summary of Manchester Development Sites at Risk of Surface Water Flooding

Development Site			Less susceptible		Intermediate susceptible		More susceptible	
Site Name	Total Area (km²)	No. Sites	Area (km²)	No.	Area (km²)	No.	Area (km²)	No.
Strategic Employment Site	116.45	7	11.27	7	4.84	7	0.69	7
Strategic Housing Site	51.42	18	3.66	18	1.78	13	0.31	10
District Centres	16.44	15	1.50	15	0.55	15	0.05	5
Capacity/SHLAA Sites	85.80	767	6.75	480	2.71	198	0.46	49
Total	**270.09**	**807**	**23.18**	**520**	**9.88**	**233**	**1.52**	**71**

Table 4-5: Summary of Salford Development Sites at Risk of Surface Water Flooding

Development Site			Less susceptible		Intermediate susceptible		More susceptible	
Site Name	Total Area (km²)	No. Sites	Area (km²)	No.	Area (km²)	No.	Area (km²)	No.
Overall Growth Point Sites	1.77	5	0.21	5	0.08	5	0.00	2
Allocations	1.29	6	0.06	6	0.02	5	0.00	2
Core Strategy SS Sites	0.27	7	0.02	5	0.01	5	0.00	1
Core Strategy SHLAA Sites	3.21	371	0.29	205	0.09	103	0.01	13
Sub Regionally Significant Sites	0.77	4	0.07	4	0.02	4	0.00	2
Core Strategy EL Sites	0.74	18	0.08	18	0.04	14	0.00	1
Regionally Significant Sites	3.50	5	0.25	5	0.11	5	0.01	4
Total	**12.13**	**429**	**1.03**	**258**	**0.40**	**147**	**0.03**	**29**

Table 4-6: Summary of Trafford Development Sites at Risk of Surface Water Flooding

Development Site			Less susceptible		Intermediate susceptible		More susceptible	
Site Name	**Total Area (km²)**	**No. Sites**	**Area (km²)**	**No.**	**Area (km²)**	**No.**	**Area (km²)**	**No.**
Strategic Locations and other development areas	17.93	18	2.03	18	0.53	18	0.01	8
SHLAA Sites	2.60	461	0.29	253	0.07	90	0.01	14
Total	**20.53**	**479**	**2.32**	**271**	**0.60**	**108**	**0.02**	**22**

5 SFRA Recommendations

5.1 Introduction

Since publication of the Pitt Review, it is apparent that SFRAs will provide the central location holder of data, information and consideration for all flood risk issues relating to flooding from all sources at a local level; and provide the linkage between CFMPs, SMPs, RFRAs, SWMPs and appropriate sustainable land uses over a number of planning cycles. Therefore, SFRAs can be used as more than a land use planning tool. They can provide a much broader and inclusive vehicle for integrated, strategic and local flood risk management, assessment and delivery.

This SFRA has been produced to be fit for the future, to help communities meet the considerable flood risk management and climate change related challenges that lie ahead. In order to achieve this, each council must take a lead role in flood risk management and continue to work on this Level 1 SFRA and increase the understanding and information available on flood risk issues. There are a number of future plans and studies which could provide this comprehensive understanding and acknowledgement of flood risk from all sources. These are outlined below with recommendations of whether or not they would benefit Manchester, Salford and Trafford.

The Sub-Regional SFRA recommended that there should be consistent flood risk policies and guidance across all AGMA councils to ensure that the forthcoming large scale development and regeneration in the sub-region can occur in an efficient and sustainable way. The creation of an AGMA-wide development and flood risk guidance document (similar to the recently released Salford City Council Planning Guidance: Development and Flood Risk) would help to ensure that a consistent approach occurs throughout the sub-region. Where there are multiple sources of risk present or complex flood risk issues the MST authorities should work closely with the Environment Agency and other stakeholders such as United Utilities, British Waterways and the Manchester Ship Canal Company to bring about a strategic response. For example, there is a complex relationship in Trafford between the Manchester Ship Canal and its contributing watercourses and the Bridgewater Canal.

Recommendations as a result of this Level 1 SFRA fall into four groups: the content of a Level 2 assessment, Surface Water Management Plans (SWMPs), Water Cycle Studies (WCS) and Green Infrastructure (GI).

5.2 Level 2 SFRA

This Level 1 SFRA has provided the evidence base for each council to help apply the Sequential Test as set out in PPS25. Whilst the suite of Flood Risk Maps provided will help inform the decision making process and go some way in informing the likelihood of passing the Exception Test, they do not provide the local understanding and the level of detail required to carry out the Exception Test.

A detailed Level 2 SFRA should be produced to gain a greater understanding of the flood mechanisms and residual risks to provide the data needed to pass part c) of the Exception Test – whether the development will be safe. The Level 2 SFRA should concentrate on strategic development sites which coincide with areas at high risk of flooding.

The investigations carried out within the Level 2 SFRA will help to produce a "flood risk balance sheet" and confirm the sequential approach to site layout and the design of possible mitigation measures.

The scope of a Level 2 SFRA is provided in PPS25 and its Practice Guide. It should include the detailed nature of the flood hazard within a flood zone including:

- Flood probability.
- Flood depth.

- Flood velocity.
- Rate of onset of flooding.

The Level 2 SFRA should also provide information on flood defences including their location, standard of protection, condition and an assessment of defences breaching and overtopping.

Flooding does not respect political boundaries and actions to manage flood risk and water from new development need to be carefully considered so that they do not increase risk downstream. Manchester City, Salford City and Trafford Councils and the Environment Agency should work together on flooding problems, particularly where actions could exacerbate flooding in downstream communities. This should be emphasised in the Level 2 SFRA through:

- Carrying out an assessment of the risk from rivers, canals and surface water on a cross authority basis (such as The River Irwell affecting Salford and Manchester or the Bridgewater Canal affecting all three authorities).
- Providing an assessment of the impact of development on flood risk, both within Manchester, Salford and Trafford and from councils upstream.
- Undertaking a review of hydraulic linkages in flood events on a cross authority basis.
- Providing recommendations for mitigation that would not have an adverse effect on flood risk elsewhere and that have taken cross boundary implications into account.

The remainder of this section provides guidance on where a Level 2 SFRA is required.

5.2.1 Manchester

The RSS advocates that 90% of development should be on previously developed land and Manchester has a target to provide 3,500 new homes every year, alongside developing commercial, industrial, recreational and public services (education, health etc.) sites. Manchester City Council is also part of the Greater Manchester Growth Point and is committed to delivering 20% more homes than the annualised average housing figure for a period of 9 years. The city is experiencing widespread regeneration activity, particularly in the Regional Centre, the Inner Areas and a number of other strategic housing and employment sites and the airport.

The Level 2 SFRA should look at the key development sites and provide the evidence base so that suitable allocations can be brought forward. To achieve this, the Level 2 SFRA should consider the following:

- Flood extent, depth and hazard in the floodplain, along the Grey Irwell, River Irk, River Medlock and Corn Brook.
- The risk of canal flooding from the Rochdale, Ashton and Bridgewater canals, including the implications of an embankment breach.
- The risk of sewer and surface water flooding (including lost watercourses).
- The hydraulic interactions between different sources of flood risk.
- The cumulative impacts of planned development in Manchester on flood risk downstream and of development elsewhere on flood risk in Manchester.

5.2.2 Salford

The RSS advocates that 90% of development should be on previously developed land and Salford has a target to provide 1,600 new homes every year, alongside developing commercial, industrial, recreational and public services (education, health etc.) sites. Salford City Council is also part of the Greater Manchester Growth Point and is committed to delivering 20% more homes than the annualised average housing figure for a period of 9 years. There are a number of regeneration initiatives in Salford including the Regional Centre, the Inner Areas and the (former) employment sites along the Manchester Ship Canal (MSC) and Bridgewater Canal.

The Level 2 SFRA should look at the key development sites and provide the evidence base so that suitable allocations can be brought forward. To achieve this, the Level 2 SFRA should consider the following:

- Flood depth and hazard in the floodplain along the River Irwell, Grey Irwell and MSC.
- Breach analysis on the River Irwell at Lower Kersal and Lower Broughton.
- The risk of canal flooding from the MSC and Bridgewater Canal, including the implications of an embankment breach on the latter.
- The risk of sewer and surface water flooding.
- The hydraulic interactions between different sources of flood risk.
- The cumulative impacts of planned development in Salford on flood risk downstream and of development elsewhere on flood risk in Salford.

5.2.3 Trafford

The RSS advocates that 80% of development should be on previously developed land and Trafford has a target to provide 578 new homes every year, alongside developing commercial, industrial, recreational and public services (education, health etc.) sites. Trafford Council is also part of the Greater Manchester Growth Point and is committed to delivering 20% more homes than the annualised average housing figure for a period of 9 years. There are a number of regeneration initiatives in Trafford including Regional Centre, the Inner Areas and includes the sites at Trafford Park, Pomona, Partington and Carrington along the Manchester Ship Canal and sites along the Bridgewater Canal.

The Level 2 SFRA should look at the key development sites and provide the evidence base so that suitable allocations can be brought forward. To achieve this, the Level 2 SFRA should consider the following:

- Flood depth and hazard in the floodplain along the River Mersey and MSC.
- Breach analysis on the River Mersey at Carrington.
- The risk of canal flooding from the MSC and Bridgewater Canal, including the implications of an embankment breach on the latter.
- The risk of sewer and surface water flooding.
- The hydraulic interactions between different sources of flood risk.
- The cumulative impacts of planned development in Trafford on flood risk downstream and of development elsewhere on flood risk in Trafford.

5.3 Surface Water Management Plans

The Pitt Review, PPS25, the Making Space for Water Integrated Urban Drainage pilots and the Draft Flood and Water Management Bill recognise the need for clearer roles and responsibilities for different sources of flood risk. The current legislative framework leads to a fragmented and piecemeal approach for managing urban flood risk. A leadership role for local flood risk issues has emerged whereby local authorities will need to have in place a strategy to manage these risks, of which an SWMP is an integral part.

Surface water flooding is a major source of flood risk and as demonstrated by the summer 2007 floods can lead to serious flooding of property and possessions. These impacts can typically be mitigated through the implementation of established 'best practice' drainage techniques including Sustainable Drainage Systems (SUDS) at the planning application stage. However, in some circumstances site constraints dictate that a catchment-wide, holistic approach to surface water flood management is required through urban catchment planning and strategic consideration of the design, construction, maintenance and improvement of sewers and watercourses. Local Authorities need to take a lead role and close liaison with water companies and the Environment Agency is essential to ensure a consistent and co-ordinated approach to surface water management. This may be best achieved by the production of appropriate SWMPs.

SWMPs are developed by a partnership between a Local Authority, water company and the Environment Agency. They provide an opportunity to:

- Develop a framework for joint working and data sharing (which is a fundamental part of flood risk management under the draft Flood and Water Management Bill).
- Collate a central geographic database of drainage assets and flood risk issues.
- Assess the likelihood of surface water flooding through various modelling approaches.
- Assess the risk of surface water flooding to people, properties and the environment.
- Communicate this risk to local communities.
- Assess the costs and benefits of various flood risk reduction measures.
- Provide a drainage strategy for areas of significant development if appropriate.
- Provide a framework for implementation and monitoring of the surface water strategy for a given area.

SFRAs provide the opportunity for local authorities to assess at a strategic level the risk from multiple sources of flooding, which can then feed into more detailed assessments where appropriate by both themselves and other operating authorities. This includes the identification of Critical Drainage Areas. Critical Drainage Areas are those identified from historical flood events and/or modelled data as having a significant risk from surface water flooding and include drainage catchments for the sewer network. Recommendations can then be made for the future provision of SWMPs in high risk locations or areas of significant development, for which an integrated drainage solution is possible, that can reduce flood risk both to the development and elsewhere.

The Defra SWMP guidance is based on the Integrated Urban Drainage pilots undertaken as part of Making Space for Water and was recently tested by six national pilot studies. SWMPs should achieve the level of data sharing with water companies and analysis using detailed sewer network models that is the next stage down from the SFRA.

On the 18th August 2009, Defra announced that they were awarding £9.7m to 77 local authorities at the highest risk of surface water flooding to undertake surface water management. Other local authorities will be able to bid for a share of £5m to deal with known local surface water flooding issues.

Due to the large number of above and below ground hydraulic interactions between the ten local authorities of Greater Manchester, the Association of Greater Manchester Authorities (AGMA) is promoting the need for a Greater Manchester-wide SWMP and in November 2009 made an application to Defra for additional funding. A Greater Manchester wide and strategic SWMP would benefit from joint working and cost efficiencies and is consistent with emerging legislative requirements (Draft Flood and Water Management Bill (2009)). Manchester City Council and Rochdale Metropolitan Borough Council have agreed to pool the funding already assigned to them by Defra if the additional funding to undertake the AGMA SWMP is awarded.

The AGMA SWMP initiative should be supported. If, however, sufficient funding is not available to undertake an AGMA SWMP, Manchester City, Salford City and Trafford Councils should form a partnership with their neighbours, United Utilities and the Environment Agency to undertake SWMPs as recommended in the Level 2 SFRA.

5.3.1 Screening for Critical Drainage Areas

Future Water (Defra, 2008) sets out the role that SFRAs can have in identifying CDAs for which more detailed Surface Water Management strategies can be developed. The recent Defra Surface Water Management Plan Guidance (2009) supports the use of SFRAs in providing the evidence base for where SWMPs are required.

It is recommended that more detailed surface water modelling is undertaken for the entire borough as part of the Level 2 SFRA. The ASSWF map provides a good indication of areas at risk of surface water flooding but this should be refined so that it picks up flow paths along roads and around buildings.

The Level 2 SFRA should use the following data to screen for CDAs:

- An understanding of areas where there is a focus for development, such as in the Conurbation Core
- Local authority incident records
- Discussions with Local Authority Drainage Engineers
- Refined surface water flood maps produced for the Level 2 SFRA
- An assessment of properties at risk based on the SFRA surface water flood map
- United Utilities sewer records and drainage areas
- United Utilities DG5 register

This exercise should be used to inform recommendations for Surface Water management Plans.

5.4 Water Cycle Studies

Water Cycle Studies (WCS) are an all encompassing study of the capacity in water supply and waste water infrastructure, aimed at those regions that are expecting growth. The main aim of a WCS is to ensure that new development can be supplied with the required water services it needs in a sustainable way. WCS are relevant to flood risk management as inadequate wastewater and sewer systems can lead to potential surface water and sewer flooding problems.

To ensure that growth at a council scale can be supplied with sufficient water and wastewater treatment facilities, without detrimentally affecting the natural water cycle, it is essential to consider the water infrastructure needs as early in the planning process as possible.

A Greater Manchester WCS would consider water supply, waste water treatment and disposal, and any related flooding issues, within the current regulatory framework that exists and consequent funding availability, and would link to SFRAs and SWMPs, amongst other things.

Until a Greater Manchester WCS is prepared, developers should consult with United Utilities about potential capacity issues in the water supply and sewage treatment networks.

5.5 Green Infrastructure Framework

Green Infrastructure (GI) is part of each council area's life support system. It is a network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and rural fringe. In general GI consists of:

- Open Spaces – parks, woodlands, nature reserves, lakes.
- Linkages – River corridors and canals, pathways and cycle routes and greenways.
- Networks of "urban green" – private gardens, street trees, verges and green roofs.

The identification and planning of GI is critical to sustainable growth. It merits forward planning and investment as much as other socio-economic priorities such as health, transport, education and economic development.

GI is also central to climate change action and is a recurring theme in planning policy statements, regional spatial strategy and the Sub-Regional SFRA.

With regards to flood risk, green spaces can be used to manage storm flows and free up water storage capacity in existing infrastructure to reduce risk of damage to urban property, particularly in city centres and vulnerable urban regeneration areas. GI can also improve accessibility to waterways and improve water quality, supporting regeneration and improving opportunities for leisure, economic activity and biodiversity.

The evidence base provided in this SFRA should be used to enhance the Greater Manchester Green Infrastructure Study. River corridors identified as functional floodplains are an excellent linkage of GI and can provide storage during a flood event. Areas identified within the urban environment or upstream of a critical surface water flood area should be incorporated into council GI strategies. Opening up land to create flow paths or flood storage areas can help protect current and future property.

In certain circumstances runoff green space can cause flooding in developed areas. This should be considered through further detailed work in a Surface Water Management Plan.

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