Strategic Flood Risk Assessment for Greater Manchester

Sub-Regional Assessment

"Living Document" – June 2008

Tameside
Bolton Council
TRAFFORD COUNCIL
Salford City Council
Wigan COUNCIL
ROCHDALE METROPOLITAN BOROUGH COUNCIL
OLDHAM Metropolitan Borough
STOCKPORT METROPOLITAN BOROUGH COUNCIL
MANCHESTER CITY COUNCIL
BURY COUNCIL
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A·G·M·A ASSOCIATION OF GREATER MANCHESTER AUTHORITIES.

Revision Schedule

Strategic Flood Risk Assessment for Greater Manchester – Sub-Regional Report
June 2008

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Abbreviations

ACRONYM	DEFINITION
AGMA	Association of Greater Manchester Authorities
AONB	Area of Outstanding Natural Beauty
CFMP	Catchment Flood Management Plan
DEM	Digital Elevation Model
DPD	Development Plan Documents
EA	Environment Agency
EP	English Partnerships
FRA	Flood Risk Assessment
GIS	Geographical Information Systems
IDB	Internal Drainage Board
LDDs	Local Development Documents
LDF	Local Development Framework
LDS	Local Development Scheme
LiDAR	Light Detection and Ranging
LPA	Local Planning Authority
ODPM	Office of the Deputy Prime Minister
PCPA	Planning and Compulsory Purchase Act 2004
PPG25	Planning Policy Guidance Note 25: Development and Flood Risk
PPS25	Planning Policy Statement 25: Development and Flood Risk
RFRA	Regional Flood Risk Appraisal
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategy
SAR	Synthetic Aperture Radar
SA	Sustainability Assessment
SFRA	Strategic Flood Risk Assessment
SPG	Supplementary Planning Guidance
SoP	Standard of Protection
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems

Glossary

TERM	DEFINITION
Aquifer	A source of groundwater comprising water-bearing rock, sand or gravel capable of yielding significant quantities of water.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change	Both natural and human actions causing long term variations in global temperature and weather patterns.
Culvert	A channel or pipe that carries water below the level of the ground.
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Floodplain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
Flood storage	A temporary area that stores excess runoff or river flow often ponds or reservoirs.
Fluvial flooding	Flooding by a river or a watercourse.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Indicative floodplain map	A map that delineates the areas that have been predicted to be at risk of being flooded during an event of specified probability.
Internal Drainage Board	Independent bodies with responsibility of ordinary watercourses within a specified District.
Inundation	Flooding.
Local Development Framework (LDF)	The core of the updated planning system (introduced by the Planning and Compulsory Purchase Act 2004). The LDF comprises the Local Development Documents, including the Development Plan Documents that expand on policies and provide greater detail. The development plan includes a core strategy, site allocations and a proposals map.
Local Planning Authority	Body that is responsible for controlling planning and development through the planning system.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Risk	The probability or likelihood of an event occurring.
Sequential Test	A risk based approach in to assessing flood risk, which gives priority in ascending order of flood risk, i.e. lowest risk first.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Stakeholder	A person or organisation that has an interest in, or affected by the decisions made within a site.

TERM	DEFINITION
Standard of Protection	The effect a Flood Risk Management asset has on the area it is designed to protect. The standard is often measured in a return period, for example the 1 in 100 year event. Standard of Protection is determined partly by the assets design and condition, but also by other factors such as climate change and altered river flows. Over time, the standard of protection may reduce due to normal deterioration in asset condition and the effects of climate change.
Sustainability Appraisal	A process used to identify if policies, strategies or plans promote sustainable development and further used for improving policies. It is a requirement for Regional Spatial Strategies under the *Planning and Compulsory Purchase Act 2004.*
Sustainable Drainage Systems	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations meeting their own needs.
Water Cycle Strategy	A Water Cycle Strategy provides a plan and programme of Water Services Infrastructure implementation, determined through an assessment of the environment and infrastructure capacity for water supply, sewage disposal, flood risk management and surface water drainage.
1 in 100 year event	Event that on average will occur once every 100 years. Also expressed as an event, which has a 1% probability of occurring in any one year.
1 in 100 year design standard	Flood defence that is designed for an event, which has an annual probability of 1%. In events more severe than this the defence would be expected to fail or to allow flooding.

1 Executive Summary

1.1 The Greater Manchester SFRA

Local Planning Authorities are required to produce Local Development Frameworks (LDFs), which are a portfolio of Local Development Documents (LDDs) that collectively deliver the spatial planning strategy for the authority area. The LDDs undergo a Sustainability Appraisal (SA) which assists Planning Authorities in ensuring their policies fulfil the principles of sustainability. Strategic Flood Risk Assessments (SFRAs) are one of the documents to be used as the evidence base for planning decisions and are a component of the SA process.

With a population of 2.5 million residents, Greater Manchester is the north of England's largest sub-regional economy and has undergone, and will continue to be a centre of, significant growth, largely concentrated in the Regional Centre and to the south of the sub-region. As Greater Manchester continues its renaissance there is a significant challenge to delivering growth in urban areas, renewing low demand housing markets, restoring degraded environments and providing high quality housing in an environmentally sustainable way in the face of climate change and existing and future flood risk.

As a result, the Manchester Authorities decided to collaborate through AGMA on the Strategic Flood Risk Assessment for Greater Manchester. The SFRA takes place within the context of PPS25[1] and its Practice Guidance[2] and emerging sub-regional frameworks as set out in the submission Regional Spatial Strategy[3] for the North West. The SFRA will provide a key element in the evidence base to inform each District's Local Development Framework.

To ensure that the SFRA addresses the needs of the individual Districts as well as providing an integrated approach to the sub-region as a whole, taking into account river catchments, the assessment is being undertaken in two distinct phases.

1. The first is a **desktop exercise**, making use of existing information to establish the broad baseline position for existing and likely future levels of flood risk for the Greater Manchester Sub-Region, and to **identify information gaps and anomalies**. As the name suggests, the SFRA is a risk assessment or framework to bring together existing information and identify where further, more detailed assessments are required.
2. The second will undertake more detailed District Level assessments to build upon the outputs of the sub-regional assessment. These will provide further information to allow the application of the PPS25 sequential test or, if necessary, the Exception Test.

[1] Planning Policy Statement 25: Development & Flood Risk, Communities and Local Government. December 2006.
[2] PPS25 Practice Guide Companion - "Living Draft", Communities and Local Government. February 2007.
[3] North West Draft Regional Spatial Strategy. January 2006.

1.2 A "Living Document"

This document represents the first phase of work – the **sub-regional assessment**. As with the PPS25 Practice Guide Companion (February 2007), this SFRA should be treated as a **"Living Document".** Due to the dynamic nature of flood risk and planning data or, in some areas, the lack of critical datasets available to the sub-region, it will be necessary to update the SFRA periodically.

Within the document are a number of short, dated "position statements" that clearly highlight issues that AGMA are aware of and that may directly affect the SFRA. As well as describing these issues, each statement also highlights how it is proposed to address each issue. As these issues and challenges are addressed, it is proposed that subsequent versions of the SFRA will provide updated position statement.

1.3 The Sub-Regional SFRA in the Context of PPS25

PPS25 recommends a hierarchical approach to flood risk assessments, starting at the regional level with Regional Flood Risk Appraisals (RFRAs) and working down through SFRAs to Site Specific Flood Risk Assessments. Following this hierarchical method, a logical and consistent approach to reducing the impacts and risk of flooding can be adopted at all levels in the planning process.

In the context of PPS25 and the accompanying Practice Guidance ("Living Draft", February 2007), the sub-regional assessment for Greater Manchester sits between an RFRA and an SFRA and seeks to provide consistent and integrated flood risk advice for strategic planning and development control across several local authority boundaries that are hydrologically connected.

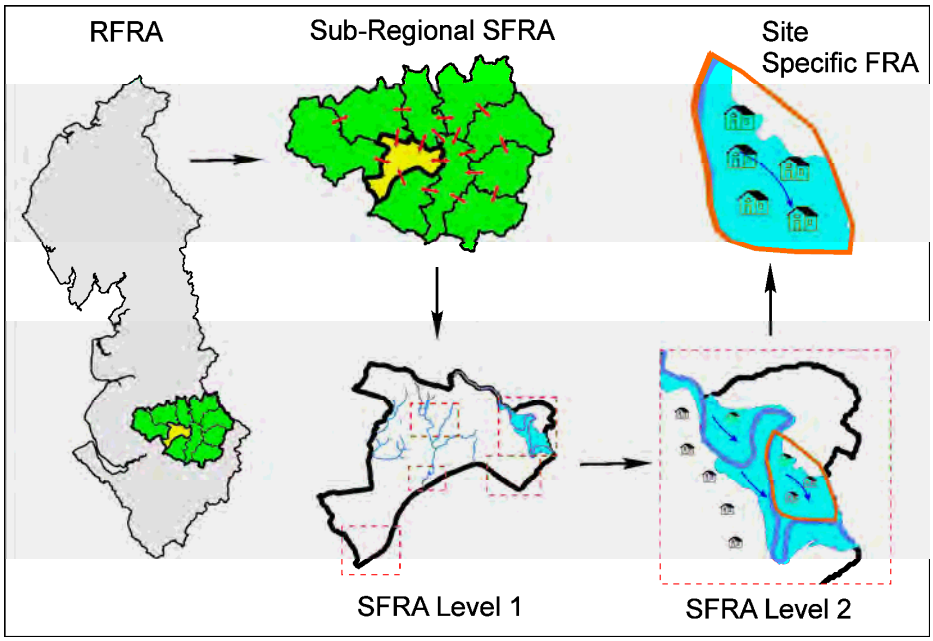


Figure 1-1: Hierarchical Approach to Flood Risk

1.4 The SFRA Methodology

The Greater Manchester Sub-Regional SFRA has been undertaken in such a way that it provides a baseline and scope from which more detailed District-Level assessments can be completed. There are two key stages in the completion of the sub-regional SFRA:

1. Two parallel studies form the Development and Policy Context and Flood Risk Review that together provide an overview of all ten councils in the context of the sub-region.
2. A Strategic Overview of Flood Risk brings together the planning and flood risk reviews to present strategic flood risk issues relevant to the AGMA Districts.

This two-staged process has been undertaken at both the sub-regional scale and also at the district scale and presents the necessary information to provide the authorities with an integrated planning and flood risk overview. At the district-level, a summary of the planning issues and flood risks has been presented using a series of information sheets, maps and schematics (Appendix B). This approach also informs the scope for additional, more detailed studies to be completed for each District. These will build upon the outputs of the sub-regional assessment and provide more information for the PPS25 sequential test and/or exception test to be applied.

1.5 Key Stakeholders & Information Provided

To carry out an appropriate and sound assessment of flood risk across the Greater Manchester sub-region, it is essential to collate and build upon the best available data and studies already carried out. In addition to each of the ten local authorities, a number of other key stakeholders were approached for information and data.

- Local Authorities
- Environment Agency
- Highways Agency
- United Utilities
- British Waterways
- Manchester Ship Canal Company

During the course of the data collection phase, it became apparent that there are some critical data gaps in available flood risk information to the Greater Manchester sub-region. The most serious of these are listed below with the current position AGMA pursuing:

Critical Data Gap	AGMA Position
The Manchester Ship Canal This represents a critical risk issue for the Manchester City Region potentially affecting Salford, Trafford and Manchester. To allow councils to make informed decisions (with regard to flood risk) on regionally important development areas abutting the MSC, it is essential that the potential impacts of extreme flows and climate change are properly assessed.	MSCC has recently completed a detailed modelling exercise of the canal[4] to determine how the canal will operate during a flood event and to enable the most efficient operational response. MSCC have provided the information to the EA to review and determine the flood risk issues, including a flood outline. This is expected in the Spring of 2009. As the MSC is such a critical issue, contact will be maintained by AGMA and the EA to ensure all parties are aware of progress and any potential challenges. In the meantime, it will be necessary for AGMA and the councils directly affected by the MSC, to take a pragmatic approach to their LDFs, tackling risk and mitigation options as information comes to light.

Critical Data Gap	AGMA Position
British Waterways Canals There are a number of canals located in the urbanised areas of the sub-region that are maintained and operated by British Waterways. Flooding has been known to occur on some of these canals. At present, the current and future flood risk associated with canals is unknown.	AGMA are to continue liaising and working with British Waterways to strive towards a mutually acceptable way of presenting potentially sensitive flood risk information associated with canals within the sub-region.
Public Sewer Flooding Data Due to the significance of sewer flooding in highly urbanised areas, the flood risk data that United Utilities hold on the public sewer network they are responsible for is classified as critical to contribute to addressing all sources of flood risk within the SFRA. However, it looks unlikely that UU will agree to the release data it holds on flood risk from the public sewer network due to data protection/sensitivity concerns.	UU have previously agreed to examine 45-50 planned development sites for each AGMA district and provide feedback on the risk of sewer flooding, water infrastructure and future capacity. In the meantime, AGMA will continue to Liaise with UU in conjunction with the EA and GONW to explore how UU can participate and contribute to the SFRA.

[4] Modelling the Manchester Ship Canal, Water and Environment Journal, Vol. 21, No. 2.

1.6 Development & Policy Context

The planning policy review collates and summarises policy and guidance relevant to planning for flood risk in the Greater Manchester Sub-Region, and comments on the extent to which existing national and regional policy reflect the aspirations of PPS25. This is done in a hierarchical approach, starting with policies that can affect flood risk issues in Greater Manchester at the European level (Water Framework Directive) and through to those that are relevant at the local level.

PPS25 (2006) has been reviewed as the key flood risk and development policy at national level, followed by the draft Regional Spatial Strategy (RSS) for the Northwest (January 2006), the subsequent Panel Report on the draft RSS (May 2007) and the Proposed Changes to the Draft RSS (March 2008). At a local level, the relevant policies for the ten local authorities: Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford and Wigan have been reviewed. The policy review covers policies pertaining to flood risk and development in flood risk areas. This review has then been expanded to explore key strategic development pressures, such as targets for housing provision, as set out by the draft RSS and the Panel Report, as these are of direct relevance when assessing flood risk.

1.6.1 Anticipated Development Patterns

Not surprisingly, Draft RSS Policy RDF1 Spatial Priorities has changed substantially since the Draft RSS was first published in January 2006. The Proposed Changes to the RSS, published in March 2008, make further changes to the wording recommended by the Panel in their report.

The proposed new wording is as follows:

- the first priority for growth and development should be the regional centres of Manchester and Liverpool;
- the second priority should be the inner areas surrounding these regional centres. Emphasis should be placed on areas in need of regeneration and Housing Market Renewal Areas in particular;
- the third priority for growth should be the following towns / cities: Altrincham, Ashton-under-Lyne, Barrow-in-Furness, Birkenhead, Blackburn, Blackpool, Bolton, Burnley, Bury, Carlisle, Chester, Crewe, Ellesmere Port, Lancaster, Macclesfield, Northwich, Oldham, Preston, Rochdale, Runcorn, St Helens, Skelmersdale, Southport, Stockport, Warrington, Widnes, Wigan, Workington/Whitehaven.

The new wording has removed the Northern (MCR4) and Southern (MCR3) emphasis from the document. However, the main emphasis for development still follows the same principals and prioritisation as described in the RSS of developing within the Regional Centre, then the Inner Areas including HMRs and finally surrounding towns.

1.6.2 Anticipated Quantum of Proposed Development

Following the production of the Draft RSS, the examination in public (EiP) and the Panel recommendations, the scale of the proposed growth within the sub-region has been defined and the published housing targets (March 2008) demonstrate the quantum of this development across all ten Districts.

AGMA submitted an expression of interest to the Department for Communities and Local Government (DCLG) on 31st October 2007 for a new growth point covering the whole of the Greater Manchester sub-region.

This submission is made against a background of strong economic and employment growth over the past five years. Economic forecasts indicate that an additional 150,000 jobs will be created over the next fifteen years as the City Region increases its contribution to the national economy. In AGMA's Expression of Interest, there are proposals to further increase and accelerate provision in response to the Housing Green Paper.

The EoI indicates that there will be additional growth in the number of homes initially in four districts; Bolton, Manchester, Salford and Trafford. The proposals will deliver housing growth in Greater Manchester which will be in excess of the ONS 2004 household projections for the sub region, which would require an average provision of 10,583 homes per annum.

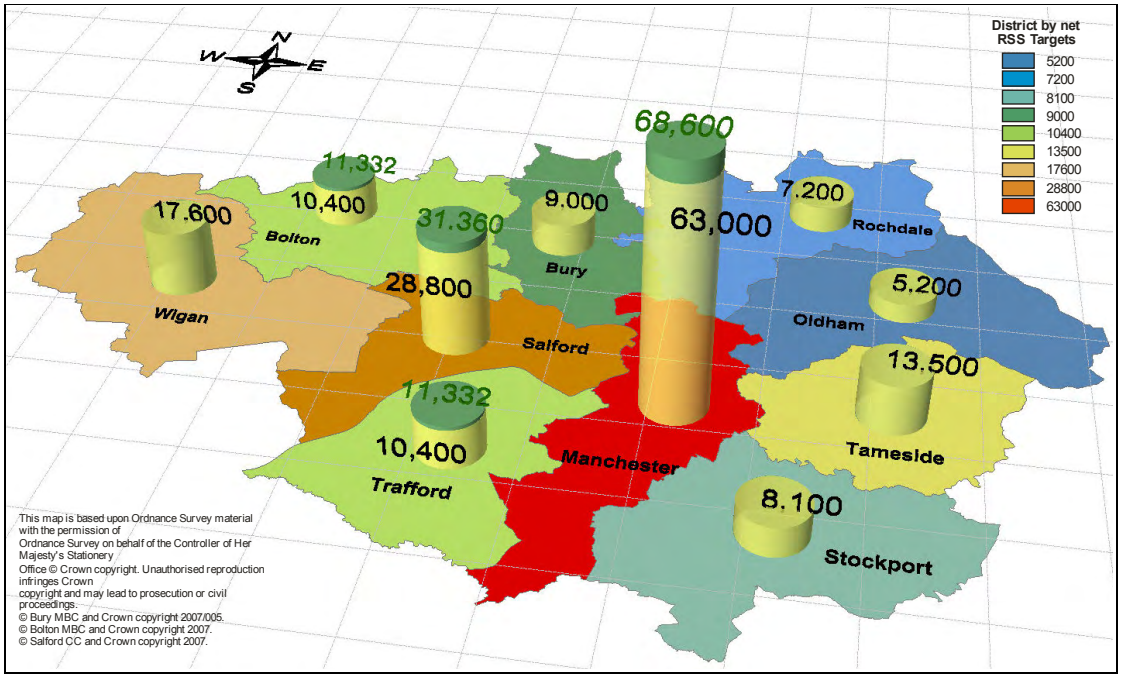


Figure 1-2: RSS Housing Targets displayed in a 3D map (yellow columns). Increases for potential New Growth Points are also highlighted (Green Columns)

1.7 Flood Risk

The Greater Manchester sub-region consists of a complex hydrological network that interlinks all of the councils. The hydrology of the sub-region is affected not only by natural features such as topography, watercourses and geology, but also by artificial influences such as canals, reservoirs and the built environment. As a result, the sub-region also has a complex mix of varying and interlinked flood sources and associated risks.

The Irwell and Mersey catchments dominate the study area, accounting for 78% of the total catchment area. Glaze Brook, the River Bollin, Sinderland Brook and the River Douglas make up the remainder of the fluvial catchments. The upper regions of the catchments tend to be steeper and have less permeable geology and are therefore more susceptible to flooding from watercourses and direct runoff as a result of high intensity rainfall events. The lower areas of the catchments consist of a more shallow topography, and have more permeable geology and tend to be dominated by fluvial flooding as a result of widespread and persistent rainfall events. All catchments within the AGMA sub-region, apart from the River Douglas, drain into the Manchester Ship Canal.

PPS25 states that an SFRA should attempt to identify all sources of flooding. Five main flood sources have been identified in the Greater Manchester sub-region and these are summarised below. In addition, historical flood events have been presented to help identify areas of flood risk.

Additional work is currently in progress to provide greater detail and, along with this sub-regional report, fulfils the requirements of a Level 1 SFRA as outlined in PPS25. This additional work includes detailed maps (at a scale of 1:10,000) to provide flood risk information at a high resolution for the Greater Manchester sub-region, a SuDS map to identify which SuDS techniques are suitable, confidence maps for each Flood Zone and a framework for specifying Level 2 SFRAs. It is recommended that, once complete, the additional work that is currently underway is included in the next update of the sub-regional SFRA.

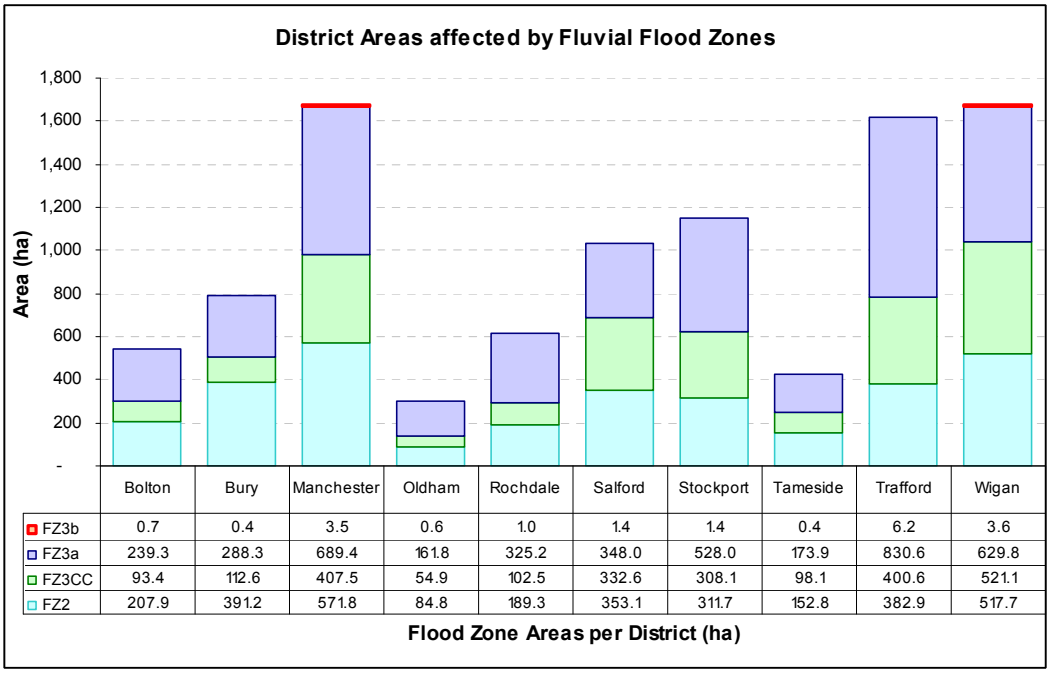
1.7.1 Flooding from Rivers

The principal source of flood risk to the Greater Manchester Sub-Region is from fluvial flooding. A significant amount of information exists for the main watercourses and their tributaries across the four main catchments (Irwell, Mersey, Douglas and Glaze Brook).

Flood Zones were created for the SFRA using a variety of existing flood risk sources including outlines from existing hydraulic models and broad-scale modelled outlines. The Flood Zones were created in GIS and each flood outline contains meta-data describing where the data was received from, a confidence level for the data and a note on its suitability for use in the SFRA.

Detailed re-definition of Flood Zone 3b is currently being completed for the whole of the AGMA sub-region. Similarly, all flood zones are currently being mapped at 1:10,000 to provide planners with a more detailed overview of the risk of flooding from rivers and to allow the application of the sequential test to be carried out.

Manchester, Trafford, Salford, Stockport and Wigan have the largest areas of fluvial flood risk in the Greater Manchester Sub-Region.



	Bolton	Bury	Manchester	Oldham	Rochdale	Salford	Stockport	Tameside	Trafford	Wigan
FZ3b	0.7	0.4	3.5	0.6	1.0	1.4	1.4	0.4	6.2	3.6
FZ3a	239.3	288.3	689.4	161.8	325.2	348.0	528.0	173.9	830.6	629.8
FZ3CC	93.4	112.6	407.5	54.9	102.5	332.6	308.1	98.1	400.6	521.1
FZ2	207.9	391.2	571.8	84.8	189.3	353.1	311.7	152.8	382.9	517.7

Figure 1-3: Area of Flood Zones By District

As the Manchester sub-region developed and grew, so watercourses were culverted, diverted, or even infilled to accommodate the amount of development associated with the industrial revolution. Some of these watercourses are known (for example, parts of the Medlock, Irk and Corn Brook). However, there are many that remain unknown or 'forgotten' and continue to flow through old culverts and tunnels beneath the City. The condition, standard of service and exact route of these culverts and tunnels is often unknown but they still present a potential flood risk to local areas in the sub-region.

Culverts carry an inherent and often unknown risk of flooding as a result of debris blockage, siltation (and hence loss of capacity) and collapse.

1.7.2 Flooding from the Land

During periods of prolonged rainfall events and sudden intense downpours, overland flow from higher ground may 'pond' in low-lying areas of land without draining into watercourses, surface water drainage systems or the ground. Pluvial and surface water flooding is most likely to occur in areas of poor permeability and limited drainage and on steeper slopes; however, there is widespread potential for occurrences across the AGMA sub-region. In some areas, pluvial flooding may present a more significant risk than other sources of flooding, including fluvial.

Historically, Manchester, Bolton, Bury, Rochdale, Stockport, Salford, Tameside and Trafford have records showing that pluvial flooding has occurred. Some council representatives have stated that there is sometimes confusion between pluvial flooding and sewer flooding when members of the public report events. Therefore, some of the historical references could refer to either pluvial or sewer flooding or a combination of both.

There is very little data available for existing or predicted surface water or pluvial flooding across the sub-region. This is classed as a critical data gap and one that AGMA are intending to address by undertaking a high level surface water modelling exercise to identify contributing catchments, flood flow routes and flood accumulation areas across the whole of the sub-region. This will assist policy and development control activities.

1.7.3 Flooding from Sewers

Sewer and drainage flooding are another flood risk throughout the AGMA sub-region, particularly during severe rainfall events, where the design capacity of the sewer network is insufficient to cope with the high volumes of water. During periods of high river flow, there is the potential for such drainage systems to become 'tide locked' and unable to discharge to watercourses, or to surcharge due to a lack of capacity, resulting in the system backing up and flooding roads and properties.

As with pluvial flooding, sewer flooding has the potential to occur anywhere within the sub-region especially as a result of the high urban density. Sewer flooding was identified using historical records and data from United Utilities DG5 database (June 2007) detailing the total number of flood incidents that have affected both internal and external property. It must be noted that DG5 data only covers a limited period of time and should be considered a snapshot of flooding. In addition, the DG5 dataset is only provided on a five-digit postcode area, which can be large and make it difficult to determine where a sewer flooding problems may have occurred in the past.

More detailed sewer flooding models, such as those produced by UU for the Defra Integrated Urban Drainage Pilot Study (IUD) in Salford provide a much more detailed and useful appreciation of the risk posed. However despite this work, it looks unlikely that UU will agree to the release data it holds on flood risk from the public sewer network due to data protection/sensitivity concerns.

In the meantime, AGMA will continue to Liaise with UU in conjunction with the EA and GONW to explore how UU can participate and contribute to the SFRA.

1.7.4 Manmade/Artificial Flooding

There are few recorded instances of flooding from the canal networks as they tend to be heavily regulated and controlled. Nonetheless, flood risk from canals and navigable waterways still exists where canals could overtop or breach. As the Ship Canal is privately run and operated, it falls outside of the remit of existing flood risk legislation and, consequently, the programme of flood risk modelling and mapping projects undertaken by the EA and local authorities.

This has led to a **'critical gap'** in the flood risk information available for the Greater Manchester Sub-Region. Similarly, the flood risk associated with canals operated and maintained by BW are also difficult to quantify as they also largely fall outside of the EAs strategic flood risk mapping projects (though in some cases, canal-river interactions are taken into account).

Similarly, there are approximately 80 reservoirs falling under the Reservoirs Act within the AGMA Districts, with up to an additional 45 contributing to them from outside the sub-region. Again, there are few recorded incidents of flooding as a result of reservoirs, though the residual risk of breaching and overtopping remains, along with the risk associated with emergency discharges. The Districts most at risk are those in the upper catchment areas, where the majority of reservoirs exist. These include Bolton, Bury, Oldham, Rochdale, Tameside and Stockport The

actual risks of overtopping or breaching of a reservoir body is a function of many factors including the condition of the actual control structures and the weather conditions of the time, as well as human error.

1.7.5 Flooding from Groundwater

Groundwater flooding tends to occur sporadically in both location and time. When groundwater flooding does occur, it tends to last longer than fluvial, pluvial or sewer flooding and mostly affects below surface infrastructure and buildings (for example, tunnels, basements and car parks). There are several principal causes of groundwater flooding which include:

- Natural groundwater rises due to exceptionally wet periods (usually over the season timescale, for example, a whole summer) where groundwater is recharged rapidly. This can reactivate springs and "dry valleys".
- Groundwater rebound due to cessation of abstraction and mine dewatering
- Shallow drainage and flooding problems due to local conditions.

Searches revealed relatively few reported incidents of groundwater flooding in the sub-region. Parts of the Upper Douglas catchment immediately adjacent to Wigan District are known to have suffered from groundwater flooding in the past. However, work undertaken by DEFRA and the EA[5] has shown that flooding from groundwater may become more of an issue due to the cessation of dewatering mines. During coal mining operations, the area was extensively dewatered, however, since coal mining in the area ceased, groundwater levels have risen.

According to the EA's water resources team and groundwater assessments, the risk posed by groundwater flooding is likely to remain remote within the sub-region, however, the impacts of increased development in Greater Manchester must be carefully assessed. For example, infiltration based SuDS methods may increase groundwater levels locally. Similarly, increases in grassed and open areas can also contribute to increased groundwater recharge in addition to a reduction in abstraction rates as a result of the heavy industry and manufacturing decline.

1.7.6 Historical Flooding

A review of information supplied by the councils, the EA, CFMP's, and through searching online historical records has revealed that numerous flood events have occurred in the sub-region over the last 150 years. A total of 89 recorded flood events were identified. It is interesting to note that of all of the identified events, most occurred during July and August with a large proportion of these floods being pluvial, sewer or combined (i.e. records show that fluvial flooding occurred as well as sewer and surface water flooding).

Salford is shown to have significant historical flooding, in particular fluvial and sewer flooding. Many of the recorded incidents are as a result of flooding from the River Irwell. Wigan has a similar number of recorded fluvial flood events as do Manchester and Trafford. These four councils also have the highest RSS housing targets and therefore potential conflicts between development pressures and flood risk start to emerge.

[5] Groundwater Flood Risk and Management in the North West Region, Environment Agency, 2007.

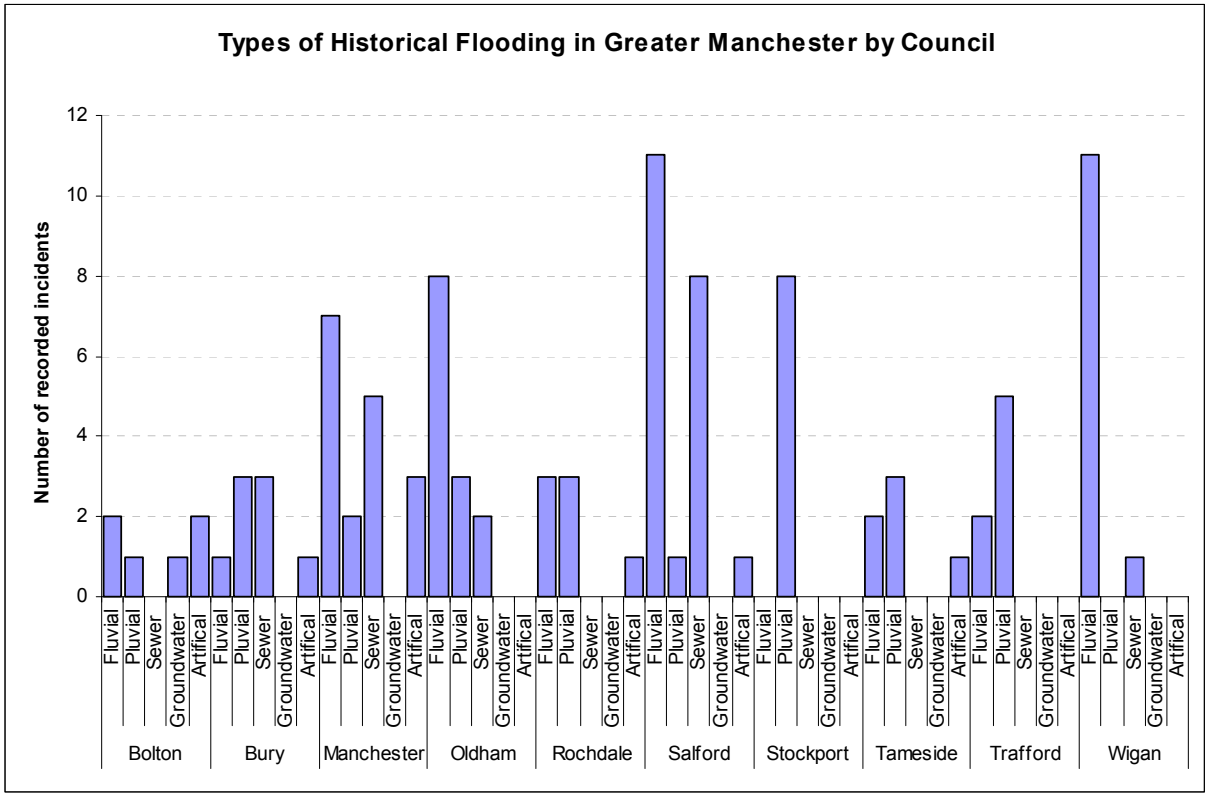


Figure 1-4: Type of Historical Flooding in Greater Manchester

1.8 Climate Change and Future Flood Risk

PPS25 updates the approach to estimating the impacts of climate change on flooding by using newer scenarios predicted by the UKCIP (UK Climate Impacts Programme – Scenarios 2002). In addition to increasing the peak flow of larger watercourses (by up to 20%), PPS25 now also includes an increase in the peak rainfall intensity of up to 30%. This will seriously affect smaller urban catchments, leading to rapid runoff to watercourses and surface water flooding, surcharging of gullies and drains and sewer flooding.

To account for climate change at the sub-regional level, fluvial FZ3 modelled outlines (including the effects of climate change) were obtained. Where there are no modelled climate change results, an estimate of the impacts of climate change on flood outlines is required. To this end, the FZ2 outlines were used as a proxy. This is not to say that the 100 year flood outline will necessarily increase to the 1000 year outline, but rather that one would expect the depth and extents of flooding to increase to somewhere between the 100 year and 1000 year outlines. This is a conservative approach designed to help strategic planners identify where increased detail and resolution in the flood outlines is needed at either more detailed District Level SFRAs or Site Specific FRAs.

Sewer and surface water flooding are likely to become more frequent and widespread under urbanisation and climate change scenarios as the amount of impermeable surfaces and runoff increase - though it has not been possible to predict this during the SFRA.

1.9 Flood Risk Mitigation and Management

Due to the history of flooding, the urban extent and the industrial heritage of the sub-region, there are numerous structures and embankments (either purpose built or natural) that contribute to flood risk management. The EA have discretionary powers to provide a flood risk management service that includes building and maintaining physical structures and raised defences and providing flood warnings.

The EA maintain and monitor a substantial range of FRM assets within the sub-region ranging from defences and structures on smaller, critical ordinary watercourses to major flood alleviation schemes such as the storage basins at Didsbury and Sale on the River Mersey. However, it should be noted that there are a great deal more “private” and “non-maintained” assets that may provide a level of protection, or indeed, increased risk to certain areas.

Bury and Bolton have more linear defences recorded in NFCDD and the greatest proportion of defence providing a standard of protection of between 50 and 100 years. They are also located in the mid to upper catchment of the Irwell and therefore providing defences to a high standard could have a big potential impact downstream by channelling and conveying more flood flows to the Districts in the lower catchment. This highlights a potential conflict between development aspirations in Bury, Bolton and Rochdale and the impacts this will have downstream on other Districts, in particular, Salford, Manchester and Trafford.

At present, there are five formally maintained flood storage areas (FSA) in the sub-region and include:

- Didsbury FSA - Mersey
- Sale FSA – Mersey
- Lilford FSA – Glaze
- Lower Kersal (Littleton Road) FSA – Irwell
- Timperley FSA – Timperley Brook

1.10 Sub-Regional Strategic Overview

1.10.1 Consequences of Upstream and Downstream Development

The main potential adverse impacts that future development may have on downstream areas is twofold:

Reduction in Floodplain: Unrestricted development in floodplains can reduce the natural flood storage capacity of a river and, consequently, convey more water downstream – especially if newly developed areas are defended to a high SoP.

Increase in Runoff: Without careful planning policies, the increase in impermeable areas as a result of new development can increase the net volume of runoff entering watercourses. This can increase flood risk downstream and reduce water quality. These effects will be increased as a result of climate change, making matters worse.

To assess the effects and consequences of development on downstream areas, hydrological link schematics were produced. These demonstrate how the different councils in the sub-region are connected and what the cumulative effects of development between them are downstream. The schematics are based on hydrological connectivity and therefore Districts outside of the AGMA sub-region may also contribute to and/or be affected by development in other Districts. As well as showing the hydrological links between Districts, the schematics also contain the revised RSS housing target figures for each District (Figure 1-5).

At a sub-regional scale, the consequences of development in one District on another become a serious issue when cumulative effect of proposed net new housing is taken into account. Within AGMA, Manchester, Trafford and Salford are potentially worst affected by housing development upstream. This is due to the fact that all three lie at the downstream extent of the catchments affecting the sub-region and, consequently receive flow from all Districts upstream. The three Districts also form part of the Inner Areas of Manchester City and the Regional Centre and, as a result form a regionally and nationally important centre.

If no measures are taken to control runoff or development in floodplains upstream, there is a serious potential for some of the new development to cause an increase in flood risk to Manchester, Salford and Trafford that could leave future development within the Manchester City Region highly exposed and vulnerable to flooding. This risk is further increased when climate change is taken into account.

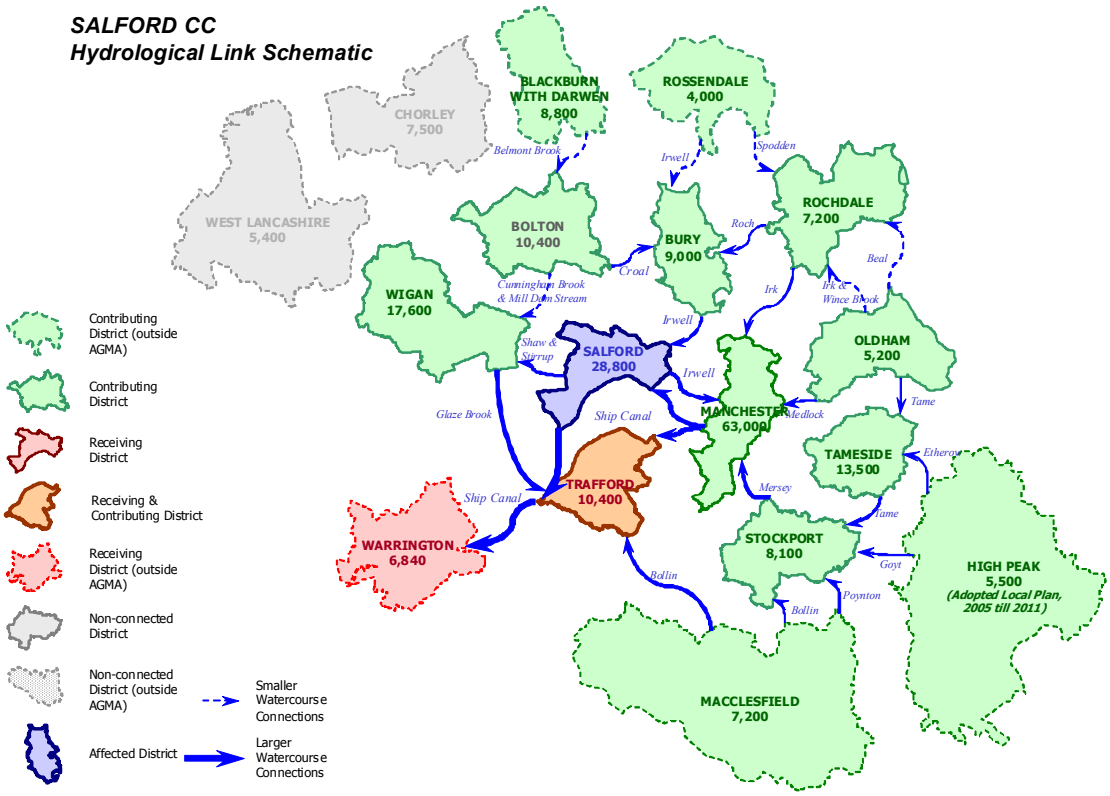


Figure 1-5: Hydrological Links between Districts

The councils upstream of Manchester, Salford and Trafford that are likely to have a significant effect on minimising the potential increase in flood risk can be split into two main groups based on catchments:

- Bolton, Bury, Oldham and Rochdale – Irwell Catchment
- Stockport and Tameside – Mersey Catchment

In addition to consistent policies across the sub-region, these groups could explore more specific flood risk policies amongst themselves that would make use of the CFMPs and help to minimise the impacts of their development on the Manchester City Region.

1.11 Potential Conflicts between Development & the PPS25 Sequential Test

The flood zone maps and records of other types of flooding within the sub-region were used in conjunction with the broad-scale RSS development map to determine areas within the sub-region and within each District where a potential conflict may exist between future development and the PPS25 Sequential Test.

The main potential conflict areas are within the regional centre where, as discussed above, the largest quantum of development is proposed with some of the most significant potential flood risk issues. However, these areas are also some of the most densely populated and intersect with major flood risk areas, including the River Irwell, the Manchester Ship Canal and the urban and hidden rivers within Manchester. It is likely that development in these areas will come into conflict with the Sequential Test and require the Exception Test to be undertaken. This will be examined in more detail during a more detailed Level 2 SFRA. Other areas where conflicts may arise are in Bury, Rochdale, Stockport and Wigan.

To the north of the Inner Areas, the main areas of potential conflict are in the town centres and their surrounds where development areas intersect with fluvial flood zones or with areas known to suffer from sewer and pluvial flooding. For example, proposed development within Bury MBC is located predominantly in Bury and Radcliffe Town Centres and their surrounds. The River Irwell flows through both towns. Similarly, development within Rochdale includes the Heywood Area, where repeated instances of sewer flooding have occurred in the past. Potential flooding from the River Douglas and Glaze Brook intersect with the development areas of Wigan.

To the South, the areas of potential conflict tend to also concentrate around town centres and their surrounds. For example, Altrincham is affected by flooding from Timperley Brook, whilst development areas to the north of the Town Centre, including Broadheath, are at risk from Sinderland Brook and potentially the Bridgewater Canal. Conflicts could also exist in Ashton-under-Lyne and Mossley in Tameside as a result of flooding from the River Tame. Other development areas in Tameside are expected to be more dispersed and therefore pluvial and sewer flooding could cause conflict with the Sequential Test.

1.12 Properties and Populations Affected by Flooding

To further refine the flood risk ranking for the AGMA Districts and to allow strategic planners to identify the numbers of people that may be affected by flooding in each District, it was necessary to undertake an analysis of populations and properties at risk.

Output Areas (OAs) from the 2001 census obtained from the National Statistics Office were used to identify the population distribution in 2001 across the AGMA sub-region. These were updated with the revised 2006 mid-term estimates. The SFRA Flood Zones were then overlaid onto the OAs to obtain an approximate population affected by flooding. These estimates are based on fluvial flood risk only and do not take into account the potential numbers of properties or populations affected by other sources of flooding, including the potential risk posed by Manchester Ship Canal.

From this analysis it is clear that Manchester CC, Salford CC and Wigan MBC currently have the greatest populations affected by flooding. This concurs with the fact that they also have the highest population densities in the sub-region and the greatest areas of land at risk of fluvial flooding. Stockport and Trafford also have a substantial population and number of properties at risk of flooding. Given the more vulnerable status given to residential development in PPS25 and the regionally important development areas, it is essential that meeting the RSS targets do not lead to a greater population being affected by flood risk.

There is presently an unquantified risk of flooding from the Manchester Ship Canal. Therefore, there are potentially more people and property currently at risk that live in areas abutting the Canal. Added to this, there is significant development proposed for areas adjacent to the canal in the Western Gateway and Regional Centre in Salford and also the Partington, Carrington, Trafford Park and Wharfside areas in Trafford.

For councils to the north and south of the RSS Inner Areas, there are currently fewer identified properties and populations affected by fluvial flood risk, however, the risk posed to properties and populations from other sources is still unquantified. It is anticipated that uncertainty in these areas can be reduced during the course of more detailed studies, including Level 2 assessments.

1.13 Strategic Flood Risk Mitigation

1.13.1 Upstream storage

Strategic options for mitigation include additional upstream flood storage and washland creation schemes. For upstream flood storage schemes to maximise benefits downstream, they need to be located in suitable areas of the catchment. Locating flood storage basins too high in the catchment could mean that a large proportion of a flood event is still able to travel downstream from other areas in the catchment.

The Irwell CFMP assessed the possibility of locating flood storage basins in the upper catchment including:

- Headwater storage in the Upper Croal catchment on Eagley Brook, Bradshaw Brook and Astley Brook;
- Headwater storage in the Upper Roch catchment including the Beal and other small tributaries;
- Washland areas to the west of Heywood in Rochdale;
- FSAs between Ramsbottom and Bury on the Irwell.

The Irwell CFMP concluded that carrying out the storage schemes individually would have limited effect on catchment wide flows, levels and damages. As a result of their relatively high placement in the catchment, the schemes have limited benefits to areas further downstream in Bury, Manchester, Salford and Trafford especially once the effects of climate change have been taken into account.

However, locating flood storage facilities in the mid-catchment areas between Bury and Salford could have more significant benefits reducing water levels in Salford by up to 1m, resulting in a reduction in damages of 30-40%. The Salford City SFRA identifies the “Castle Irwell Basin” and

the Irwell CFMP refers to it as one of the only suitable sites in the Irwell catchment that will have a significant strategic impact on reducing flood risk. .

In the Tame, Goyt and Mersey Policy Units (PUs 3-6) presented in the Draft Upper Mersey CFMP, there are suggestions for flood storage areas and washlands at:

- the Tame and Mersey and the Goyt and Mersey Confluences
- the Goyt at Goyt Hall Farm, Marple Dale and Brabyns Park
- the Tame at the golf course south of Woodhouse.

These are all located upstream of Trafford in Stockport and Tameside. As a result of implementing these schemes, the CFMP suggests that the fluvial flood risk to people in properties falls by 74%, to property alone falls by 7%, economic damages fall by 28% and agricultural risk falls by 14%.

To meet the costs of upstream storage schemes, and other catchment and AGMA wide flood risk management options, AGMA could adopt and implement a local tariff-based system into the local development plan process of each council. The system could also be run on the sub-regional basis to fund large flood risk mitigation/management schemes across the Greater Manchester area.

Furthermore, and working closely with the outputs from the current sub-regional Green Infrastructure Study, careful landuse planning and the gradual reinstatement of green open spaces together with wetlands and woodlands throughout the catchment will help to reduce runoff, identify, restore and create floodplains which further reduce the cumulative flood risk across catchments.

1.13.2 Sustainable Drainage Systems (SuDS)

Further strategic flood risk mitigation options include the implementation of common policies on SuDS throughout the AGMA sub-region. Consistent policies across the sub-region would ensure that, where possible, runoff from new development within a whole catchment is reduced therefore contributing to more sustainable flood risk management across several councils.

Should each of the 173,200 homes (Table 3-1) in the sub-region incorporate small-scale, individual SuDS in addition to larger, site or area scale SuDS, the potential attenuation effects and reduction in runoff could be substantial.

1.14 Conclusions & Recommendations

The SFRA has identified significant flood risk to areas in the sub-region and Manchester, Salford and Trafford appear to have the greatest potential risk. The three councils also have (collectively) the greatest number of properties and populations at risk and, as mentioned above, the largest development targets in the sub-region. A significant potential conflict exists in these councils between development pressures and level of flood risk. Other areas where conflicts may arise are in Bury, Rochdale, Stockport and Wigan.

Large areas of uncertainty in flood risk data still remain, including the Manchester Ship Canal and pluvial and sewer flooding. It is hopeful that data defining flood risk from the MSC will be provided by the EA by 2009. Similarly, identifying flood risk hotspots as a result of sewer flooding may also be possible with the use of detailed sewer modelling data from UU, however it is unlikely that this

will be forthcoming. In the meantime, UU have agreed to examine 45-50 planned development sites for each AGMA district and provide feedback on the risk of sewer flooding, water infrastructure and future capacity.

Given the scale of development, it is recommended that a Water Cycle Study (WCS) is carried out for the Greater Manchester sub-region. This will identify the water infrastructure pressures and requirements to fully meet the scale of development proposed in the sub-region.[6]

Consistent flood risk policies and guidance across all AGMA councils will 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 would help to ensure that a consistent approach occurs throughout the sub-region.

The guidance document could also address potential funding schemes to ensure that strategic flood mitigation measures can be developed and that SuDS methods can be maintained and operated correctly. One such scheme could be an AGMA-wide development levy that would be introduced to developments in areas of flood risk to raise the necessary mitigation and maintenance funds.

Recommendations include:

- Undertaking more detailed mapping (1:10,000 scale) across the AGMA sub-region. This will assist councils in undertaking the PPS25 Sequential Test (this is currently being completed).
- Creating a SuDS map for the entire sub-region to assist in allocations work and development control activities (this is currently being completed).
- Undertake a broad-scale Pluvial/Surface water modelling exercise across the sub-region to identify catchments, flood flow routes and ponding areas (feasibility of this study is now being looked into).
- Update SFRA with MSC flood risk modelling data when this becomes available.
- Update SFRA with Medlock, Irk and the Lower Irwell “Gap” flood risk modelling data when this becomes available.
- Carry out more detailed Level 2 studies in key locations (a Level 2 Framework is currently being completed).

[6] Refer to Environment Agency ‘Water Cycle Strategies…Providing Solutions to Sustainable Development’ http://www.environment-agency.gov.uk/commondata/acrobat/water_cycle__1760254.pdf

2 Introduction & Methodology

The Planning and Compulsory Purchase Act 2004 (PCPA) (HMSO, 2004) requires Local Planning Authorities to produce Local Development Frameworks (LDFs) to replace the system of Local, Structure and Unitary Development Plans. Local Development Frameworks are a portfolio of documents (Local Development Documents (LDDs)) that collectively deliver the spatial planning strategy for the authority area. The PCPA 2004 requires LDDs to undergo a Sustainability Appraisal (SA) which assists Planning Authorities in ensuring their policies fulfil the principles of sustainability. Strategic Flood Risk Assessments (SFRAs) are one of the documents to be used as the evidence base for planning decisions; they are also a component of the SA process and should be used in the review of LDDs or in their production.

The release of Planning Policy Guidance Note 25: Development and Flood Risk in July 2001 (PPG25)(DTLR, 2001) introduced the responsibility of Local Authorities to ensure that flood risk is understood and managed effectively using a risk-based approach as an integral part of the planning process.

PPG25 was superseded by Planning Policy Statement 25: Development and Flood Risk (PPS25) in December 2006. PPS25 re-emphasises the active role that Local Authorities should take in ensuring that flood risk is considered in strategic land use planning. PPS25 encourages Local Planning Authorities to undertake SFRAs and to use their findings to inform land use planning. In February 2007, a "Living Draft" of the Practice Guidance for PPS25 was released for consultation. Although this is a consultation document, the approach to SFRAs that it suggests should be considered. The draft practice guide refers to sub-regional SFRAs but only includes information on the outputs for regional and level 1 and 2 assessments.

To assist Local Authorities in their strategic land use planning, SFRAs should present sufficient information to enable Local Authorities to apply the Sequential Test to proposed development sites. The SFRA should have regard to river catchment wide flooding issues and also involve a:

> *"Process which allows the Local Planning Authority to determine the variations in flood risk across and from their area as the basis for preparing appropriate policies for flood risk management for these areas".*

In addition, where development sites cannot be located in accordance with the Sequential Test as set out in PPS25 (i.e. to steer development to low risk sites):

> *"The scope of the SFRA should be increased to provide the information necessary for the application of the Exception Test."*

In addition to being a tool for use in strategic land use planning, an SFRA should also be accessible and provide guidance to aid in the general planning process of a local authority.

2.1 The Greater Manchester SFRA

Greater Manchester is a polycentric sub-region with a series of towns grouped around Manchester and Salford. With a population of 2.5 million residents, Greater Manchester is the north of England's largest sub-regional economy and has undergone, and will continue to be a centre of, significant growth, largely concentrated in the Regional Centre and to the south of the sub-region.

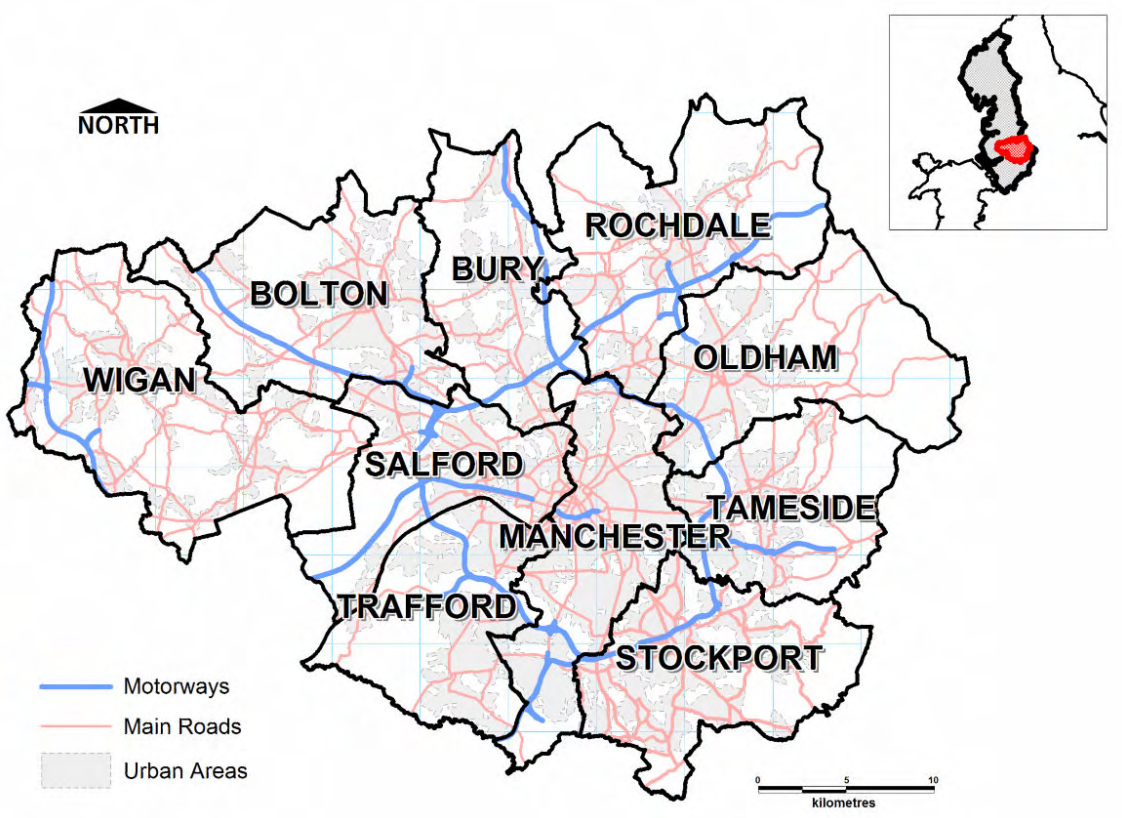


Figure 2-1: The Greater Manchester Sub-Region[7]

The Association of Greater Manchester Authorities (AGMA) is an umbrella organisation that represents the ten Districts in Greater Manchester.

1. Bolton MBC
2. Bury MBC
3. Manchester CC
4. Oldham MBC
5. Rochdale MBC
6. Salford CC
7. Stockport MBC
8. Tameside MBC
9. Trafford MBC
10. Wigan MBC

The 1985 Local Government Act devolved power to local areas and led to the abolition of the Greater Manchester Council in 1986. However, the Act also recognised that there were some

[7] The south eastern part of Oldham District falls within the Peak District National Park

functions that needed to be co-ordinated at a metropolitan level and, as a result, AGMA was formed to undertake these functions. The ten local authorities within the Greater Manchester sub-region co-operate on a number of issues, both statutory and non-statutory, where there is the possibility of improving service delivery by working together.

As Greater Manchester continues its renaissance there is a significant challenge to delivering growth in urban areas, renewing low demand housing markets, restoring degraded environments and providing high quality housing in an environmentally sustainable way in the face of climate change and existing and future flood risk.

As a result, the Manchester Authorities decided to collaborate through AGMA on the Strategic Flood Risk Assessment for Greater Manchester. The SFRA takes place within the context of PPS25[8] and its Practice Guidance[9] and emerging sub-regional frameworks as set out in the submission Regional Spatial Strategy[10] for the North West. The SFRA will provide a key element in the evidence base to inform each District's Local Development Framework.

To ensure that the SFRA addresses the needs of the individual Districts as well as providing an integrated approach to the sub-region as a whole, taking into account river catchments, the assessment is being undertaken in two distinct phases.

1. The first is a desktop exercise to establish the broad baseline position for existing and likely future levels of flood risk for the Greater Manchester Sub-Region, and to identify information gaps and anomalies. As the name suggests, the SFRA is a risk assessment or framework to bring together existing information and identify where further, more detailed assessments are required.

   More detailed work, including detailed maps (1:10,000 scale), SuDS guidance, Flood Zone confidence maps and a Level 2 Framework, is currently being completed (June 2008) and together with the sub-regional report will fulfil the Level 1 requirements, as outlined in the PPS25 Practice Guide.

2. The second will undertake more detailed work to build upon the outputs of the sub-regional assessment. These will provide further information to allow the application of the PPS25 sequential test or, if necessary, the Exception Test.

[8] Planning Policy Statement 25: Development & Flood Risk, Communities and Local Government. December 2006.
[9] PPS25 Practice Guide Companion - "Living Draft", Communities and Local Government. February 2007.
[10] North West Draft Regional Spatial Strategy. January 2006.

2.2 SFRA Aims & Objectives

The aims and objectives of the Greater Manchester SFRA are set out in the brief dated January 2007 and are designed to ensure that due regard has been given to flood risk issues as part the strategic planning process. The principal aims are:

a) To assess and identify the different levels of flood risk (high, medium or low) and sources of flooding (main river, Critical Ordinary Watercourse (COW), surface water, canal, reservoir etc) across Greater Manchester, at both the sub-regional level (using river catchments) and District level and to map these for statutory land use planning purposes. This will be defined in terms of PPS25 and tied into the statutory planning process.

b) To undertake District flood risk assessments that will supplement current policy guidelines (i.e. PPS25) and provide a 'risk based' approach to policy making and development control within Greater Manchester. This is intended to provide clarity and inform both local authority officers and developers, ensuring that, where flood risk is identified as a relevant issue that must be addressed as part of the application process, the degree of mitigation required is appropriate to the scale of development and/or risk faced.

The achievement of these aims will enable the Greater Manchester Planning Authorities to implement PPS25 and steer vulnerable development and redevelopment away from those areas that are at highest risk of flooding, whilst also identifying opportunities for development of infrastructure that offers wider sustainability benefits (e.g. Green Infrastructure). This will ensure that regeneration areas and future allocations that are exposed, and potentially contribute to flood risk, can be developed in a safe and sustainable manner.

Therefore, in order to achieve the aims of the Greater Manchester Strategic Flood Risk Assessment, the following objectives should be achieved:

- Prepare an existing Baseline SFRA for the Greater Manchester sub-region, recognising the impacts of River Valley Catchments (see Sub-Regional SFRA report, in particular Section 4 and Section 5).
- Prepare more detailed flood risk information at the district level (see Section 4 and Appendix B).
- To ensure the Greater Manchester SFRA is sufficiently robust and sound to form part of the LDF evidence base and follows best practice and national guidance (see Section 3).
- That the Greater Manchester SFRA builds on the work undertaken by the Environment Agency on Flood Risk Zones and existing and emerging Catchment Flood Management Plans (CFMPs) (see Section 4, Appendix A and Appendix B).
- That the Greater Manchester SFRA has clear links to other spatial considerations, studies and strategies including Local Authority Emergency Plans, Site Contamination and Land Stability Registers, Wildlife and Habitat Management Plans etc. (see Section 3, Section 5 and Appendix B).
- Ensure the project is delivered so that each District has timely information which is in synergy with their Local Development Scheme key milestones, and that the information contributes to the soundness of DPDs (see Section 3.1.6).

2.3 SFRA - a "Living Document"

As with the PPS25 Practice Guide Companion (February 2007), this SFRA should be treated as "Living Document". Due to the dynamic nature of flood risk and planning data or, in some areas, the lack of critical datasets available to the sub-region, it will be necessary to update the SFRA periodically.

In addition, the SFRA is taking place during a time of changing policy. During the summer of 2007, widespread flooding affected the UK from a number of different sources. Following the floods, there have been several reviews undertaken by various organisations. The government commissioned an independent review by Sir Michael Pitt. As of May 2008, the final recommendations from the review had not been published. However, following the interim report published in the Spring of 2008, it is possible that there could be several recommendations with potential changes or updates to existing policies and the flood risk regulatory and management structure across the country.

The impacts of newly available flood risk data or of new policy guidelines on strategic planning and development control within the sub-region could be significant and therefore keeping SFRA up-to-date will ensure that it provides up-to-date information and conforms to the latest guidelines (where possible). As a result, it is recommended that users of the SFRA check with AGMA to ensure they hold the most recent version.

Within the document are a number of short, dated "position statements" that clearly highlight issues that AGMA are aware of and that may directly affect the SFRA. As well as describing these issues, each statement also highlights how it is proposed to address each issue. As these issues and challenges are addressed, it is proposed that subsequent versions of the SFRA will provide updated position statement.

2.4 The Sub-Regional SFRA in the Context of PPS25

PPS25 recommends a hierarchical approach to flood risk assessments, starting at the regional level with Regional Flood Risk Appraisals (RFRAs) and working down through SFRAs to Site Specific Flood Risk Assessments (Figure 2-2). Following this hierarchical method, a logical and consistent approach to reducing the impacts and risk of flooding can be adopted at all levels in the planning process.

In the context of PPS25 and the accompanying Practice Guidance ("Living Draft", February 2007), the sub-regional assessment for Greater Manchester sits between an RFRA and an SFRA and seeks to provide consistent and integrated flood risk advice for strategic planning and development control across several local authority boundaries that are hydrologically connected.

PPS25 and the accompanying Practice Guidance ("Living Draft", February 2007) refer to sub-regional SFRAs:

> *Because local authority areas do not follow river catchment boundaries and a catchment-based approach to flood management is desirable, local authorities should always consider the possibility of working in partnership to develop SFRAs at a sub-regional level. (2.28)*

> *Where sub-regional SFRAs are undertaken, these will provide more detailed information than the RFRA on the broad spatial distribution of flood risk within extensive areas of Flood Zone 3, where development is to be considered, but where it will be necessary to apply the Exception Test. (2.27)*

Although the Practice Guide clearly states the outputs required for an RFRA and an SFRA, it does not specifically state what the outputs of a sub-regional SFRA should be. An RFRA for the North West Region has not been undertaken and, as a result, the SFRA for Greater Manchester has addressed some issues for the sub-regional scale that might otherwise have been included in the RFRA (Figure 2-3), for example, presenting a broad overview of flood risk across the sub-region, identifying potential flood risk management measures and informing more detailed sub-regional and district-level studies. It should be noted, however, that the EA have produced a flood risk ranking for the North West to help inform the Draft RSS.

Similarly, the sub-regional SFRA has also substantially addressed many of the Level 1 SFRA objectives within PPS25 including:

- Substantial flood risk and planning data collection, review and analysis.
- Plans showing the whole LPA area, Main Rivers and ordinary watercourses that also include Flood Zones Maps for FZ3 (including 3a and 3b) and FZ2. These also include climate change (on FZ3a) that is, in some cases, approximated using other Flood Zones.
- Broad-scale narrative on potential for groundwater flooding and causes.
- Plans showing areas or points at risk from other flood sources and historical flooding information.
- Areas where broad-scale development may be located within an LPA and an assessment of the general implications this development may have on other LPAs.
- Flood Risk Management measures at the sub-regional and whole district scale.
- Guidance on the likely suitability of SuDS at the sub-regional and whole district scales.

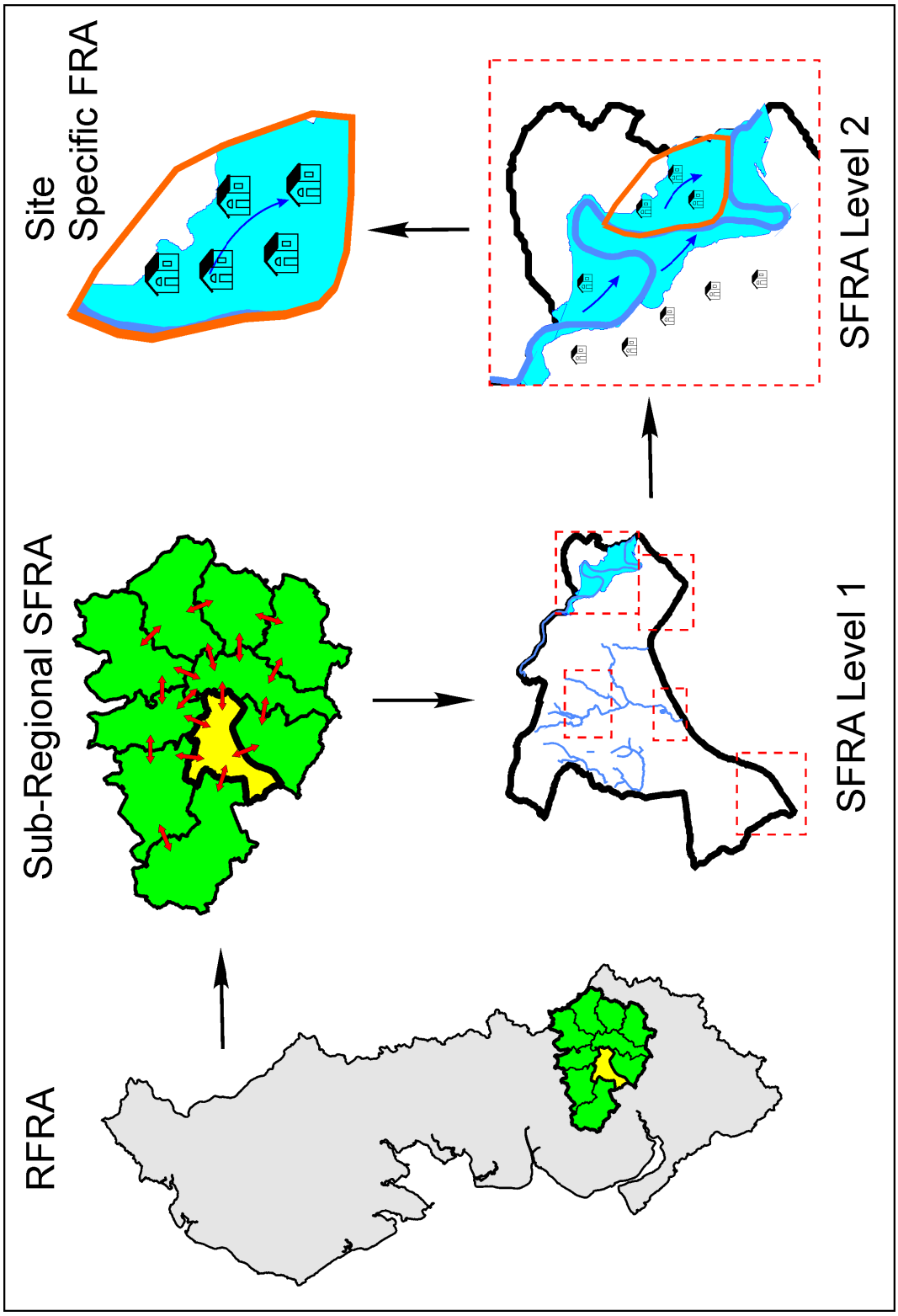


Figure 2-2: The Hierarchical Approach to Flood Risk Assessments

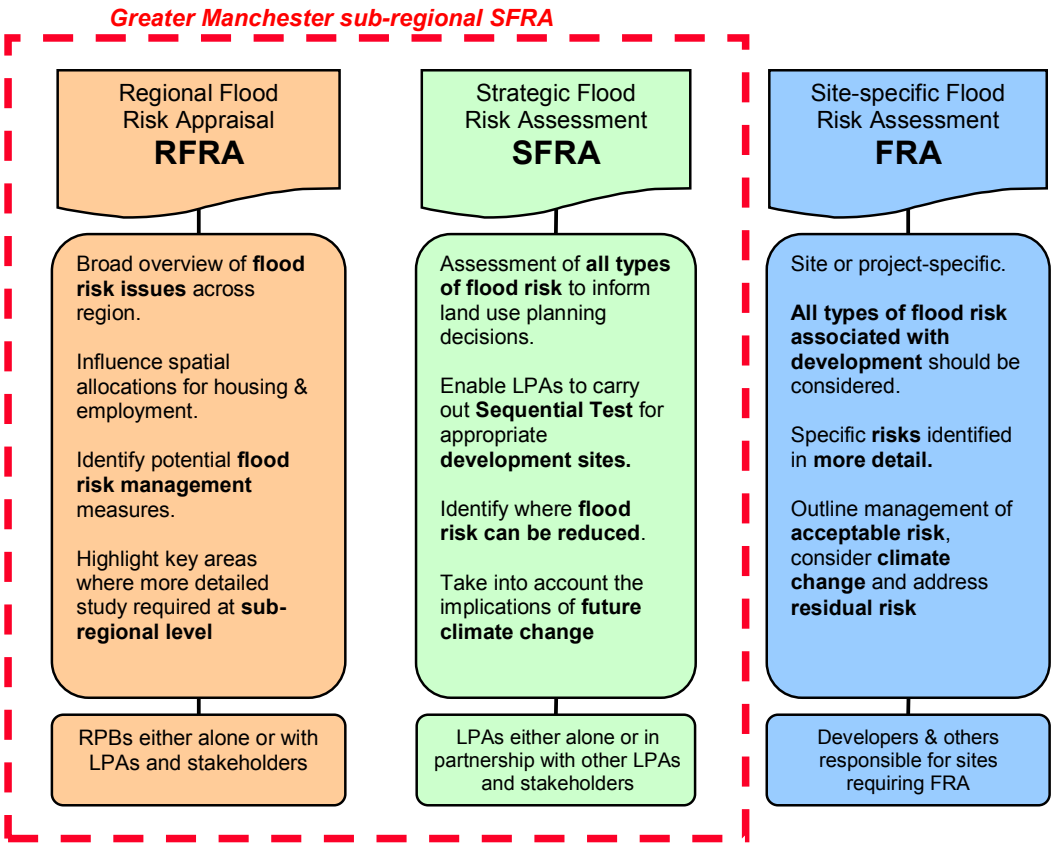


Figure 2-3: The Hierarchical Approach to Flood Risk Assessments (adapted from Figure 2.3, PPS25 "Living Draft" Practice Guide Companion (February 2007)).

However, there are certain Level 1 outputs not currently included in the sub-regional SFRA but are now being completed and these include:

- Plans at a higher resolution (1:10,000) of the AGMA area showing flood risk information, local flood defence outputs and local flood warning and flood watch areas.
- Guidance on site-specific FRAs for all broad-scale development area within individual districts.
- Guidance on SuDS for all broad-scale development areas within a District. This will reflect the current and proposed urban density, geological and soil conditions and suitability of particular SuDS techniques.
- Guidance on undertaking the PPS25 Sequential Test for potential development sites within identified broad development areas as part of a Level 2 Framework.

In addition, there are certain items that have not been addressed in the sub-regional SFRA and have been identified as critical data gaps. These include:

- A more detailed assessment of drainage and sewer flood risk at a district scale and also at a development area/site scale (see Position Statement, page 32).
- Assessment of risks from Manchester Ship Canal using modelled results from the Manchester Ship Canal Company for Salford, Trafford and Manchester (see Position Statement, page 34).

Level 2 outputs will be completed during more detailed assessments that will be informed by and build upon the outputs from this sub-regional SFRA.

2.5 The SFRA Structure & Approach

The Greater Manchester Sub-Regional SFRA has been undertaken in such a way that it provides a baseline and scope from which more detailed District-Level assessments can be completed. Following data collection and consultation, there are two key stages in the completion of the sub-regional SFRA:

3. Two parallel studies form the Development and Policy Context and Flood Risk Review that together provide an overview of all ten councils in the context of the sub-region.
4. A Strategic Overview of Flood Risk brings together the planning and flood risk reviews to present strategic flood risk issues relevant to the AGMA Districts.

This two-staged process has been undertaken at both the sub-regional scale and also at the district scale and presents the necessary information to provide the authorities with an integrated planning and flood risk overview. At the district-level, a summary of the planning issues and flood risks has been presented using a series of information sheets, maps and schematics (Appendix B). This approach also informs the scope for additional, more detailed studies to be completed for each District. These will build upon the outputs of the sub-regional assessment and provide more information for the PPS25 sequential test and/or exception test to be applied.

An important task was to identify, within each of the ten authorities, those areas and locations that are of regional significance, contributing to the economic growth of the region as a whole. Based on the Draft North West RSS, areas at the sub-regional level that play a complementary role have also been identified, as potentially they contribute to the growth of the sub-regional economy. This enabled spatial priorities driving growth and development within the sub-region to be understood. Based on the Draft RSS, maps of those locations where future development will occur were produced that highlight the key drivers of spatial policy within the sub-region.

There was some variance in the quality and format of the information available and it has been necessary to make certain assumptions in order to ensure consistency in approach and cohesiveness of the format of the assessment. These assumptions are:-

- The total number of houses to be built accords with the trajectories and projections set out within Annual Monitoring Reports.

- The most up to date information on distribution of housing has been used to identify spatial priorities for growth. Where appropriate, this included an LDF core strategy options paper and/or the most recent local/UDP document.
- For Unitary Development Plans that did not include spatial priorities (or were very out of date), the RSS sub-regional policies subtext to policy L4, as amended by the Panel Report and the brown field land targets were used.
- There is no reference to RPG13
- The AGMA New Growth Point Proposals include a commitment by Manchester, Salford, Trafford and Bolton to a 20% increase of housing figures over and above the draft RSS Panel Report figures, for the 8 years 2008-2016, MCC 4200pa net, SCC 1920pa net, Trafford 694pa net and Bolton 694pa net.

2.5.1 Development & Policy Context and Flood Risk Review

Development and Planning Context

The development and planning context was conducted on a staged basis, commencing with national and regional policies and working down through the sub-regional scale to the district-level polices. This has ensured that relevant polices, at the relevant scales, inform the SFRA at the sub-regional level and the district-level. Information has been sought from a variety of different sources to ensure that all relevant planning and spatial strategy polices have been reviewed.

Each of the ten Districts has been consulted individually. Contact has also been made with authorities outside of the AGMA sub-region. This has established a framework of existing and future policies that may impact on or inform the sub-regional and District-level SFRAs.

Flood Risk Review

In a similar approach to the planning policy review, the flood risk review has taken place on a staged basis, with catchment-wide policies being reviewed first, followed by district-level studies and area based strategies. This has enabled the framework of existing flood risk policy to be developed and presented for the whole of Greater Manchester and then further broken down into districts and groups of districts.

All sources of existing and potential future flood risk have been identified (as prescribed in PPS25) using all relevant information available at the time. This has included (but not been limited to) developing hydrological schematics, examining CFMPs, Flood Defence Strategies and other flood risk documents, reviewing the existing Salford SFRA, historical flood records and information from United Utilities, British Waterways and the Manchester Ship Canal Company.

This information is summarised using a broad-scale assessment for the sub-region, in which a set of flood risk patterns, trends and statistics is presented to allow strategic planners to quickly identify trends, key issues and potential conflicts with planning aspirations.

2.5.2 Strategic Overview of Flood Risk

The Strategic Overview of Flood Risk brings together the development and policy context and flood risk reviews to identify potential conflicts between planning pressures and flood risk areas. Using these combined datasets, the report demonstrates which councils are likely to have the greatest flood risk and development challenges now and in the future. It also highlights the potential flood risk impacts that one council may have on others downstream whilst also examining the effects of defence failure and possible strategic mitigation options. The analysis at the sub-regional and District scales has been used to draw conclusions as to the flood risk and planning pressures for each District, and to develop recommendations for more detailed studies as part of the SFRA.

2.6 Data Collection and Stakeholder Consultation

To carry out an appropriate and sound assessment of flood risk across the Greater Manchester sub-region, it is essential to collate and build upon the best available data and studies already carried out. In addition to each of the ten local authorities, a number of other key stakeholders were approached for information and data. The data collected must help to achieve the outputs specified by AGMA for core strategy preparation whilst also addressing the requirements of PPS25.

Most of the data collected has been used and built upon to form the basis of this study. However, there is a proportion of the information collected that is too detailed for use at the sub-regional assessment. It is anticipated that this data will be used for more detailed district-level assessments (if and when required) that will build upon and follow the sub-regional assessment.

2.7 Key Stakeholders & Information Provided

2.7.1 Local Authorities

Each of the AGMA Districts was contacted to provide information, advice and data on flood risk and planning issues across their administrative areas. One to one meetings were also held with each District to determine what stage each is at in their LDF process and how their LDF programme is emerging. Useful consultation and meetings with the councils were held to determine the future development aspirations of each District and the general pattern of development across the sub-region, including how and where RSS housing and employment targets may bet met. The process has highlighted the different circumstances of each council and the fact that each is at a different stage in their LDF process.

In addition to their planning and development aspirations, the councils were asked if they held any records of previous flooding issues within their administrative areas. A number of councils were able to provide details of surface water, fluvial and sewer flooding within their boundaries and several site specific flood risk assessments were provided to add resolution and detail to existing flood risk data.

Due to their differences, the type, format and emphasis of information received from each council varied. This presented a challenge when attempting to compare councils on a like for like basis and determine a sub-regional 'picture' of potential development within Greater Manchester that could be used in a strategic overview of flood risk.

2.7.2 Environment Agency

The Environment Agency (EA) is the principal holder of flood risk data in the UK. The EA has discretionary powers under the Water Resource Act (1991) to manage flood risk and, as a result, are the holders of the majority of flood risk data available in the study area. Greater Manchester falls within the North West Region of the EA and is administered by the South and Central Area offices.

Various meetings have been held with the EA to determine what information could be made available for the SFRA and to discuss how to best use the data. A full list of the data provided by the EA can be found in Appendix D but can be summarised as:

- Catchment Flood Management Plans (CFMP) for the Upper Mersey (Draft), Mersey Estuary (Draft), Irwell (Pilot) and Douglas catchments;
- Strategic Flood Risk Mapping (SFRM) outlines and supporting data;
- Details and locations of historical flood events;
- LiDAR Digital Terrain Model and other survey;
- Details and locations of flood defence assets and flood warning procedures;
- Details, locations and results from hydrometric monitoring sites.

The EA have also assisted with advice on the Water Framework Directive (WFD) as well as internal strategic projects being carried out at a national and regional level. Similarly, the EA have assisted in the production of the SFRA by providing expert advice and comment and informing the steering group of the current progress on existing and planned flood risk projects that affect the sub-region.

2.7.3 Highways Agency

Major roads and motorways have the potential to significantly impact on flood risk by affecting flood flow routes, crossing watercourses (by bridge or culvert) and potentially increasing surface water runoff. To this end, the Highways Agency (HA) is an important stakeholder in the SFRA. The HA have provided details on planned major strategic road improvement schemes that will have an impact on the Greater Manchester Area including the M60 Ten Year Strategy (covering proposed widening of certain stretches and junction improvements) and advised on the South East Manchester Multi Modal Study (SEMMMS). SEMMMS includes the South East Manchester Relief Road scheme jointly proposed by Cheshire County Council, Manchester City Council and Stockport Metropolitan District Council.

2.7.4 United Utilities

United Utilities (UU) provide potable water distribution and waste water collection for the whole of the Greater Manchester sub-region. United Utilities have provided a register of flood events that have affected properties (internal) and outside areas such as roads (external) to a five-digit postcode area. This information is provided to the regulatory body – OFWAT (Office of Water Services) and is used to help define their capital programme. The register is also known as the DG5 register, and contains commercially sensitive information as well as information covered by the Data Protection Act (1998). As a result, a detailed analysis of the scale, consequences and risks of sewer flooding has not been possible at this stage of the SFRA.

To a highly urbanised conurbation such as Greater Manchester, the risks and consequences of sewer flooding are potentially very serious. Although not on the same scale as large fluvial flood events, sewer flooding can affect more properties and people more frequently. As a result, it is essential that an assessment of the scale and distribution of potential sewer flooding (taking into account climate change) is undertaken as part of the SFRA. This will allow strategic planning to incorporate the risks of sewer flooding and to allow for mitigation where possible.

SFRA Position Statement May 2008

United Utilities Data

Due to the significance of sewer flooding in highly urbanised areas, the flood risk data that UU hold on the public sewer network they are responsible for is classified as critical to contribute to addressing all sources of flood risk within the SFRA.

The foundations for a future working partnership between UU and AGMA have been established through the integrated Urban Drainage Pilot Study (including Salford City Council the EA and other partners). However despite this joint work, it looks unlikely that UU will agree to the release data it holds on flood risk from the public sewer network due to data protection/sensitivity concerns.

However, UU have previously agreed to examine 45-50 planned development sites for each AGMA district and provide feedback on the risk of sewer flooding, water infrastructure and future capacity.

In the meantime, AGMA will continue to Liaise with UU in conjunction with the EA and GONW to explore how UU can participate and contribute to the SFRA.

2.7.5 British Waterways

Due to the industrial heritage of Greater Manchester, it is served by an extensive network of canals. Together with Manchester Ship Canal Company (MSCC), British Waterways (BW) maintains and operates the principal navigation routes in the area including:

- The Leeds/Liverpool Canal
- The Rochdale Canal
- The Manchester Bolton & Bury Canal
- The Huddersfield Narrow Canal
- The Ashton Canal
- The Peak Forest Canal
- The Leigh Branch
- The Bridgewater Canal (operated by MSC)

As the flows into and out of canals are heavily regulated, flooding is rare, though historical records show that it has occurred at locations within the sub-region. Flooding can occur as a result of overtopping of canal banks, adjacent to emergency relief sluices (paddles) or, in very rare cases, as a result of an elevated embankment failure. BW provided GIS layers and data together with advice. Information on potential flooding from canals can be sensitive and BW is currently determining how best to present this data in the public domain.

SFRA Position Statement **May 2008**

British Waterways Data

There are a number of canals located in the urbanised areas of the sub-region that are maintained and operated by British Waterways. Flooding has been known to occur on some of these canals. At present, the current and future flood risk associated with canals is unknown.

AGMA are to continue liaising and working with British Waterways to strive towards a mutually acceptable way of presenting potentially sensitive flood risk information associated with canals within the sub-region.

2.7.6 Manchester Ship Canal Company

The Manchester Ship Canal is the main navigation route from the coast at Merseyside into the centre of Manchester at Salford – a total distance of 55km. The canal is owned and maintained by the Manchester Ship Canal Company (MSCC) and operates under its own Act of Parliament (1885). In addition to providing navigation, the canal also drains the Irwell, Upper Mersey and Glaze Brook catchments, which is a total area of over 3,000km^2. As a result, the canal plays a vital part in the prevention of flood risk through central Manchester (including Manchester CC, Salford CC and Trafford MBC) and further downstream in the neighbouring authority of Warrington. The MSCC also owns the Bridgewater canal.

However, as the canal is privately run and operated, it falls outside of the remit of existing flood risk legislation and consequently, the programme of flood risk modelling and mapping projects undertaken by the EA and local authorities. This has led to a 'gap' in the flood risk information available for the Greater Manchester Sub-Region.

SFRA Position Statement **May 2008**

Manchester Ship Canal

The Manchester Ship Canal (MSC) represents a critical risk issue for the Manchester City Region potentially affecting Salford, Trafford and Manchester. To allow councils to make informed decisions (with regard to flood risk) on regionally important development areas abutting the MSC, it is essential that the potential impacts of extreme flows and climate change are properly assessed.

In depth discussions have been held with MSCC to determine what, if any, flood risk information and knowledge is available for use. MSCC has recently commissioned a detailed modelling exercise of the canal[11] to determine how the canal will operate during a flood event and to enable the most efficient operational response. This exercise has now been completed. MSCC have provided the information to the EA to review and determine the flood risk issues, including a flood outline.

Once the EA and MSCC are satisfied with the outcomes, it is understood that the data will be made available to AGMA for use in the SFRA. Though exact timescales are not available at present, it is thought that the exercise will be complete in the Spring of 2009.

As the MSC is such a critical issue, contact will be maintained by AGMA and the EA to ensure all parties are aware of progress and any potential challenges. In the meantime, it will be necessary for AGMA and the councils directly affected by the MSC, to take a pragmatic approach to their LDFs, tackling risk and mitigation options as information comes to light.

Until this data is available, it is recommended that Development Control procedures require site-specific FRA's for proposed development sites adjacent to the Manchester Ship Canal.

2.7.7 Other Information Sources

In addition to the main stakeholders, a number of other parties were consulted and information sources interrogated.

2.7.7.1 Neighbouring Authorities

Each of the neighbouring authorities to the Greater Manchester sub-region were contacted to ask whether they had completed an SFRA and at what stage in their LDF process they were at. A mixed response was received, with many authorities referring to their websites for their most up-to-date information. Warrington MBC is completing an SFRA at the time of writing, as is Chorley (as

[11] Modelling the Manchester Ship Canal, Water and Environment Journal, Vol. 21, No. 2.

part of the Central Lancashire SFRA). Macclesfield DC is currently undertaking an SFRA in partnership with Congleton DC.

2.7.7.2 ASCCUE Project (Manchester University)

The ASCCUE (Adaptation Strategies for Climate Change in the Urban Environment) project was a study undertaken collaboratively by the University of Manchester, the University of Cardiff, the University of Southampton and Oxford Brooks University.

The project aimed to further the understanding of the impacts and risks of climate change on towns and cities through three 'exposure units'; human comfort, urban green space and the built environment. One of the aspects examined was surface water runoff during extreme rainfall events. The outputs from this project have been used to inform the sub-regional SFRA on future flood risk and it is expected that additional use will be made of the data during more detailed, district-level studies of the SFRA.

2.7.7.3 Office for National Statistics (ONS)

Results from the 2001 census and the official mid-term estimates of population growth to 2006 to identify population numbers and types of properties at risk of or affected by flooding in the Greater Manchester Area.

2.7.7.4 Forthcoming Data

SFRA Position Statement June 2008

Forthcoming Data

The following data sources have recently been released or are soon to be published:

Planning Policy Statement 25: Development and Flood Risk Practice Guide (released June 2008)

River Irwell Catchment Flood Management Plan Consultation Draft Report (released May 2008)

The Pitt Review: Learning the Lessons from the 2007 Floods (released June 2008)

These sources of data have not been considered in this sub-regional report. Since this document is a "living draft", future updates will take consideration of the above documents.

2.8 Data Review

All received data was registered on receipt and its accuracy and relevance reviewed to assess a confidence levels for contribution to the SFRA (Table 2-1). This process was purely subjective and was based on both planning and flood risk experience. Details of all the data collected at the time of production are presented in Appendix D.

Table 2-1: Method for qualitative confidence ranking of data received

		RELEVANCE		
		1 - VERY RELEVANT	2 - PARTLY RELEVANT	3 - NOT RELEVEANT
ACCURACY	1 - EXCELLENT	**VERY GOOD**	GOOD	GOOD
	2 - GOOD	GOOD	GOOD	FAIR
	3 - FAIR	GOOD	FAIR	FAIR
	4 - POOR	FAIR	FAIR	POOR
	5 - VERY POOR	FAIR	POOR	**VERY POOR**

Most data requested was both relevant and accurate as was expected. Some datasets were very detailed and localised and therefore have less applicability at the sub-regional scale, for example, accounts of sewer flooding incidents at individual properties. However, it is anticipated that this data will be used during any, more detailed, District Level SFRAs.

As stated above, most data received was relevant to the SFRA and also accurate. There were, however, some instances where information received was of less use in the strategic assessment of flood risk. This is more a reflection of the lack of data rather than the quality of the data. For example, British Waterways have helpfully provided GIS layers of the canal network they maintain within the sub-region. However, BW are not in a position to provide data and information indicating flood risk, either historical or future. It is anticipated that BW may be in a position to provide more detailed information during the course of any more detailed assessments.

2.9 Data Gaps and Confidence

Table 2-2 below summarises the main sources of data (together with the provider) used in the SFRA. The table highlights the overall confidence level (Green – High, Amber – Medium, Red – Low) assigned to the data group and also shows where critical data gaps exist (as discussed above in Section 2.7). Where a critical data gap is flagged as red, it has a potentially significant flood risk and should be investigated in more detail. One of the purposes of Table 2-2 is to allow the identification of additional data that is required to fully complete the SFRA either through additional, more detailed studies, or through further negotiations with data providers.

Table 2-2: Summary of Confidence for main data sources and critical data gaps.

PPS25 SFRA Flood Risk Data	Principal Data Provider(s)	Data Types	General Confidence	Exceptions / Critical Data Gaps	Comments
Fluvial Flooding	Environment Agency / Local Authority	Flood Zone 2	Med-High	No Modelled Flood Outline for Medlock or Corn Brook through Central Manchester	
		Flood Zone 3a	Med-High		FZ3a in Manchester has low confidence. It is currently being reviewed by the EA, the results of which should be incorporated into the SFRA as soon as possible.
		Flood Zone 3b	Med-High		
		Climate Change	Low - Med	Flood Outlines taking into account Climate Change for all FZs	Most modelled FZ3a outlines have an allowance for Climate Change. However, it is rare that other FZs include climate change.
		Historical Flooding	Med-High		
Surface Water Flooding	Highways Agency, Local Authorities	Existing Flooding	Low - Med	Very little data exists. No modelled surface water flood data. No Climate Change consequences.	
		Potential Flooding	Low		Most data is historical and lacks detailed information. No modelled data and no climate change data.
		Climate Change	Low		
Public Sewer Flooding	United Utilities	Existing Sewer Flooding	Low - Med		UU have provided DG5 dataset at the 5 digit postcode scale. This is a snapshot of historical flooding and not a true indication of the level of risk posed by sewer flooding.
		Potential Sewer Flooding	Low	Public sewer models not available for use in SFRA at this time.	AGMA will continue to liaise with UU over the provision of sewer modelling indicating flood risk.
		Climate Change	Low		

Table 2-2: Summary of Confidence for main data sources and (continued)

PPS25 SFRA Flood Risk Data	Principal Data Provider(s)	Data Types	General Confidence	Exceptions / Critical Data Gaps	Comments
Groundwater Flooding	Environment Agency / GMGU / Local Authorities	Groundwater Emergence	Medium		The EA have highlighted that due to the cessation of mine dewatering, groundwater levels have risen in parts of the AGMA sub-region. However, the risk of flooding remains slight.
		Existing GW Flooding	Low		
		Potential GW Flooding	Low - Med		
		Climate Change	Low		
Flooding from Artificial Sources	EA / British Waterways / Manchester Ship Canal Company	Reservoirs	Medium		Impacts and consequences of flooding/failure currently not available for use in SFRA.
		British Waterways Canals	Low	Little or no information available for use in SFRA at this time.	BW have provided GIS data only. No condition, risk or history of flooding has been provided at this time.
		Manchester Ship Canal	Low	Model of MSC not available for use in SFRA at this time.	MSCC completed hydraulic model of canal. EA are converting to flood model and outlines, expected in 2009. MSC is critical as borders major development areas.
		Climate Change	Low		The effects of climate change on canal flooding is unknown.
Flood Risk Management	Environment Agency / Local Authority	FRM Assets	Medium		NFCDD dataset provided by EA. This is largely completed, however the database is still being populated and is likely to improve.
		Flood Warning Areas	High		Fluvial flood warning areas have been provided by the EA.

3 Development and Policy Context

The aim of the development and policy context is to collate, review and analyse relevant data at a scale appropriate to the sub-region district levels. Combining this information with the flood risk review (Section 4) highlights potential conflicts between flood risk and planning policy within the sub-region.

3.1 Policy Context

The planning policy review collates and summarises policy and guidance relevant to planning for flood risk in the Greater Manchester Sub-Region, and comments on the extent to which existing national and regional policy reflect the aspirations of PPS25. This is done in a hierarchical approach, starting with policies that can affect flood risk issues in Greater Manchester at the European level and through to those that are relevant at the local level.

PPS25 (2006) has been reviewed as the key flood risk and development policy at national level, followed by the draft Regional Spatial Strategy (RSS) for the Northwest (January 2006) and the subsequent Panel Report on the draft RSS (May 2007). At a local level, the relevant policies for the ten local authorities: Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford and Wigan have been reviewed. The policy review covers policies pertaining to flood risk and development in flood risk areas. This review has then been expanded to explore key strategic development pressures, such as targets for housing provision, as set out by the draft RSS and the Panel Report, as these are of direct relevance when assessing flood risk.

3.1.1 European Policy

3.1.1.1 Water Framework Directive (December 2000)

The Water Framework Directive (WFD) is a substantial piece of EU legislation and the largest directive related to water to date. The directive came into force on 22nd December 2000, and establishes a new, integrated approach to the protection, improvement and sustainable use of Europe's rivers, lakes, estuaries, coastal waters and groundwater. The directive requires that all member states manage their inland and coastal water bodies so that a “good status” is achieved by 2015. This aims to provide substantial long term benefits for sustainable management of water.

The Directive introduces two key changes to the way the water environment must be managed across the European Community:

1. Environmental & Ecological Objectives. The WFD provides for Protected Areas and Priority Substances to safeguard uses of the water environment from the effects of pollution and dangerous chemicals. In addition, important ecological goals to protect, enhance and restore aquatic ecosystems are set out.

2. River Basin Management Plans (RBMPs). RBMPs are the key mechanism to ensure that the integrated management of rivers, canals, lakes, reservoirs and groundwater is successful and sustainable. RBMPs aim to provide a framework in which costs and benefits can be properly taken into account when setting environmental and water management objectives. It should be noted that an RBMP is a high-level document producing very broad-scale outputs and recommendations.

Each RBMP must apply to a "River Basin District" (RBD) (a geographical area which is defined based on hydrology – see Annex 1, DEFRA & WAG River Basin Planning Guidance (RBPG), August 2006). The RBD that is relevant to the Greater Manchester Sub-Region is the North West RBD (equivalent to the EA North West Region and including several major and very different river catchments). The river basin planning process involves setting environmental objectives for all groundwater and surface water (including estuaries and coastal waters) within the RBD, and designing steps and timetables to meet the objectives. The EA is responsible for implementing the WFD in England and Wales and aim to have completed draft RBMPs by 2009.

According to the DEFRA and WAG River Basin Planning Guidance (August 2006), a RBMP should be a strategic plan that gives all stakeholders within a RBD some confidence about future water management in their District. It should also set the policy framework within which future regulatory decisions affecting the water environment will be made.

Although RBMPs specifically address sustainable water management issues, the WFD also requires that other environmental considerations and socio-economic issues are taken into account. This ensures that the policy priorities between different stakeholders are balanced to ensure that sustainable development within RBDs is achieved.

As a result of the strategic nature of RBMPs, they are inherently linked to and can both influence and be influenced by planning policy within their areas. The following sections are extracted from the DEFRA and WAG River Basin Planning Guidance (August 2006).

Spatial Plans Influencing RBMPs

Emerging development plans will be an important source of information on future water management pressures that can inform the EA and refine its understanding of the current status of water bodies, and how this might change if no action was taken. The RBPG stresses the importance of taking into account the continuation of sustainable human development (including ports, recreational uses, water storage and flood risk management schemes) within RBDs and the setting of water management frameworks.

The EAs Catchment Flood Management Plans (CFMPs) and Catchment Abstraction Management Strategies (CAMS) are examples of such high-level planning tools that can inform development of RBMPs. Using CFMPs, the Regional Flood Risk Appraisal (RFRA) and Strategic Flood Risk Assessments (SFRAs) will build upon existing flood risk and planning information to present current and potential future development within RBDs in relation to flood risk. In addition, policies that emerge from these studies (for example SuDS, Flood Risk Management procedures and mitigation options) will inform the development of the water management frameworks in RBMPs. The Greater Manchester Sub-Regional SFRA should play an important role in informing the water management framework in the emerging North West RBMP.

RBMPs Influencing Spatial Plans

As well as being informed by various spatial and catchment wide plans and strategies, RBMPs should produce strategic, regional policy information that is necessary to feed into the spatial planning process such as Local Development Frameworks. For example, where RBMPs have a direct affect on the use and development of land they will have to be material considerations in the preparation of statutory development plans for the areas they cover. It will also be necessary for planning authorities to consider WFD objectives at the detailed development control stage (not

least to consider the requirements of Article 4(7) of the WFD in relation to new physical modifications).

To allow local authorities to incorporate WFD objectives into their various statutory development plans, the Environment Agency will provide local authorities with information such as CFMPs, CAMS and other catchment-wide guidance and strategies, to enable effective integration of the water management framework within statutory development plans. In order to address the fact that these plans have different planning cycles and are at different stages in their development, RBMP policies that affect the development and use of land must be considered in the monitoring and review of statutory spatial plans.

In addition, some of the measures necessary to achieve WFD objectives will be delivered through land use planning mechanisms. For example spatial planners can make major contributions to WFD objectives by including appropriate planning conditions and planning obligations in relevant planning permissions for new developments, or by restricting some forms of development. Delivery of these measures is more likely to take place if they are included in Local Development Frameworks/Plans by land use planners. As stated above, the GMSFRA should inform the RBMPs and, as a result, the LDFs being prepared by the individual AGMA authorities should already include policies and recommendations relating to flood risk management and development within catchments.

3.1.2 National Policy

3.1.2.1 Planning Policy Statement 25: Development and Flood Risk (December 2006)

Planning Policy Statement 25 (PPS25) is supported by a Practice Guide Companion ("Living Draft", March 2007) and builds on the principles set out in PPG25 (July 2001). PPS25 seeks to guide the preparation of Strategic Flood Risk Assessments and the location of development in order to avoid and manage flood and residual risk. The PPS also aims to reduce flood risk to and from new development through policies on layout and design. PPS25 reaffirms that all forms of flooding and their impact on the natural and built environment are imperative planning considerations.

PPS 25 sets the following minimum requirements for the appraisal, management and reduction of flood risk:

- Identify land at risk from flooding and the degree of risk.
- Preparing Regional Flood Risk Appraisals or Strategic Flood Risk Assessments (RFRAs / SFRAs) as appropriate, either as part of the Sustainability Appraisal of their plans or as a freestanding assessment;
- Frame policies for the location of development which avoid flood risk to people and property, where possible and manage any residual risk, taking into account climate change;
- Reduce flood risk to and from new development through location, layout and design, including sustainable drainage approaches;
- Use opportunities offered by new development to reduce flood risk;
- Only permit development in areas of flood risk when there are no suitable alternative sites elsewhere and the benefits outweigh the risks from flooding;

- Work with the Environment Agency and other stakeholders to ensure that best use is made of their expertise and information in informing planning decisions; and
- Ensuring spatial planning supports flood risk management and emergency planning.

A Risk-based Approach

PPS25 presents a three-tier approach to flood risk assessment at the regional, strategic and site-specific levels. At the regional level this will be in the form of a Regional Flood Risk Appraisal (RFRA) and at the local level a Strategic Flood Risk Assessment (SFRA). Policies and proposals should be established on the basis of flood risk assessments.

PPS25 indicates that the Regional Planning Body should take flood risk into consideration when determining strategic planning considerations in the Regional Spatial Strategy (RSS). The RSS, guided by the RFRA, should identify broad locations and establish locational criteria for development in the region. This in turn will inform Strategic Flood Risk Assessments and consequently Local Development Documents at the local level.

Key requirements for SFRAs:

- Strategic Flood Risk Assessments (SFRAs) will refine information on the probability of flooding, taking into account all sources of flooding and the impacts of climate change. SFRAs should have regard to catchment-wide flooding issues that affect that area.
- The SFRA should provide the foundation from which to apply the sequential and exceptions tests in the development allocation and development control process (see flood Zones 1-3b). Where decision-makers have been unable to allocate all proposed development and infrastructure in accordance with the Sequential Test, taking account of the flood vulnerability category of the intended use, it will be necessary to increase the scope of the SFRA to provide the information necessary for application of the Exception Test.
- SFRAs should be prepared in consultation with the Environment Agency, emergency response and drainage authority functions of the LPA and where appropriate Internal Drainage Boards.
- Development should not add to flood risk and should, where possible, reduce it.

SFRAs should identify the four key flood zones:

Flood Zone 1: Low Probability of Flooding
Land having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)

Flood Zone 2: Medium probability of Flooding
Land having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) nor between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any report.

Flood Zone 3a: High Probability of Flooding
Land having a 1 in 100 annual probability of river flooding (>1%) or a 1 in 200 annual probability of flooding from the sea (>0.5%) in any year.

Flood Zone 3b: Functional Floodplain

Land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency.

Minimum requirements (set out in Annex E) for flood risk assessments are that they should:

a) be proportionate to risk and appropriate to the scale, nature and location of the development.
b) consider risk of flooding to the development and risk arising from the development.
c) consider the impacts of climate change.
d) be undertaken early, by competent people.
e) consider adverse and beneficial effects of flood management infrastructure and consequences of failure.
f) consider vulnerability of those occupying the development, taking account of the Sequential and Exception Tests, the vulnerability classification and safe access arrangements.
g) Ensure that assessments are fit for purpose by ensuring that different types of flooding are considered and quantified. Flooding should be considered from natural and human sources and joint cumulative effects should also be considered. Flood Risk reduction measures should be identified.
h) The effects of flooding events (including extreme events) on people, property, the natural and historic environment and river and coastal processes should be considered.
i) The remaining residual risk reduction measures should be included. It should be demonstrated that this is acceptable for the particular development/land use.
j) The ability of water to soak into the ground may change with development and this should be considered, as should how the proposed layout of the development may affect drainage systems.
k) Assessments should be supported by appropriate data and information including historical data on previous events.

Annex E also identifies that there may be considerable benefits in LPAs within a catchment area of high development pressure or a designated development area, joining together to undertake a sub-regional SFRA. This will assist LPAs to consider the issues raised by flooding on the wider scale, and enable them to contribute to, and take account of, the Water Framework Directive and River Basin Management Plans, which must be published by the EA by 2009. Para 2.27 of the Companion Guide to PPS 25, states that where sub-regional SFRAs are undertaken, these will provide more detailed information on the broad spatial distribution of flood risk and development and identify, within extensive areas of Flood Zone 3, where development is to be considered, and where it will be necessary to apply the Exception Test.

PPS 25 in Context

It is important to see Planning Policy Statement 25 Development and Flood Risk (PPS25) as part of a wider integrated approach to spatial planning. Flood risk should be considered alongside other spatial planning concerns such as the delivery of housing, economic growth, management of natural resources, regeneration and the management of other natural hazards. There are clear links to other Planning Policy Statements that may not be explicit in PPS 25, but which are necessary to achieve its objectives. The most obvious link is with the supplement to PPS1 “Climate Change and Sustainable Development” (December 2007).

3.1.2.2 Draft PPS1 Supplement "Climate Change and Sustainable Development"

PPS1 is the Government's overarching statement on the purpose of the planning system. Paragraph 3 of the PPS makes clear that 'sustainable development is the core principle underpinning planning'. The draft PPS 1 Supplement sets out important objectives in order to tackle climate change, sea level rise and avoid flood risk. The purpose of design policies should be to ensure that developments are sustainable, durable and adaptable to natural hazards such as flooding.

PPS 25 is clearly a key part of the Government's programme of responses to the challenge of climate change. If climate change is not stabilised (mitigated) then this will have two impacts on flood risk. Projected sea level rises would suggest that the risk of flood defence levels being overtopped would increase. Second, climate change is likely to create higher rainfall in winter, and consequently to increase the risk of flooding along river catchments. An increased frequency of intense rainfall events is also likely to increase the numbers of urban and flash floods, and could also mean increases in the extent of flooding from rising groundwater.

3.1.2.3 PPS3 Housing

PPS3 Housing sets out the Government's broad policy objectives for planning for housing and those policies it considers will help to realise those objectives, including the efficient use of land, variety of household types and supply, affordability and designing for quality. Via the consideration of climate change and flood risk, PPS3 aims to deliver housing policies that seek to minimise environmental impact.

PPS25 strongly supports the strategy for housing set out in PPS3. In meeting the objective of increasing housing supply the assessment of flood risk is crucial. Via the incorporation of local flood mitigation measures such as Sustainable Urban Drainage Systems and good quality design and site layout, it is possible to build safely and to manage flood risk.

3.1.2.4 PPS7 Sustainable Development in Rural Areas

PPS7 sets out the Government's planning policies for rural areas, with the protection and enhancement of the natural and historic environment, the quality and character of the countryside and existing communities all of crucial importance. The PPS states that any development in rural areas should consider flood risk at all stages of the planning process in order to reduce future damage.

3.1.2.5 PPS9 Biodiversity and Geological Conservation

The Government's planning policies on the protection of biodiversity and geological conservation via the planning system are outlined in PPS9. Crucially, many protected sites fall within flood zones and there is also an imperative to consider the impact of removing woodland on carbon sinks and on flooding.

There is also a grave risk that if land is used for development because its value in respects other than productive capacity is limited, the pressure on less productive land for production may increase in the future. In the case of increased flood risk, any adverse affects arising from the development of land should be avoided rather than minimised.

3.1.2.6 PPS 11 Regional Spatial Strategies

PPS11 sets out the Government's policy on the preparation of Regional Spatial Strategies - what they should cover and how they should be prepared and revised. The RSS should articulate a spatial vision of what the region will look like by the end date of the strategy, and how it will contribute to achieving sustainable development objectives. The RSS must, importantly for flood risk, address regional or sub-regional issues that cross local authority boundaries, working in consultation with LPAs and other stakeholders to identify the circumstances in which a sub-regional approach should be applied. Annex 4 of PPS11 sets out the policies and guidance that should be considered and covered by the RSS, including climate change, water, and the requirements of PPS25.

3.1.2.7 PPS12 Local Development Frameworks

PPS12 sets out the Government's policy on the preparation of local development documents, which together comprise the Local Development Framework. Key issues include the consideration of climate change and the need to identify local areas at risk from flooding and to highlight the geographical location of such areas on the adopted proposals map. The preparation of all local development documents must be informed by a Sustainability Appraisal. Gathering information on flood risk is an important element of assembling the baseline information for these assessments.

A Core Output Indicator which must be reported on in the Annual Monitoring Report is the number of planning permissions granted contrary to the advice of the Environment Agency.

3.1.3 Regional Policy

National policy must be interpreted through the prism of regional priorities for the North West of England. Greater Manchester borders Cheshire, Lancashire and Merseyside, and is inextricably linked to the wider development of the region. It is imperative that the regional context is considered when assessing flood risk. The regional context is defined by the emerging Regional Spatial Strategy (RSS) for the Northwest, which current includes the Draft RSS submitted January 2006, the subsequent Panel Report on the draft RSS (May 2007) and the Proposed Changes to the Draft RSS, published for public consultation in March 2008.

3.1.3.1 Submitted Draft Regional Spatial Strategy For The North West Of England (January 2006), The North West Regional Spatial Strategy Review Panel Report (May 2007) and the Proposed Changes to the Draft Regional Spatial Strategy for the North West (March 2008)

The draft RSS for the North West was submitted in January 2006, following a very tight delivery programme of 18 months. The Review Plan commented on this tight timeframe in the introductory paragraphs to their report:

> *"It is not for us to comment on the rights and wrongs of this process, or to assign blame, but we are clearly concerned with the outcome – which is that the Strategy is deficient in a number of respects" (para 2.2 and 2.3, Panel Report).*

The following section sets out an analysis of the existing Draft RSS policies as they relate to flood risk, the Panel's concerns and subsequent recommendations for amendments and the Proposed Changes published for consultation in March 2008. The subsequent implications for the SFRA are also addressed below.

Further to this, given that the RSS has not yet been adopted and policy reviews are on-going, the most up-to-date anticipated growth patterns must be kept in mind during any discussion of the RSS. These will likely inform the ongoing preparation of the RSS and planned early partial review of housing policies. Section 3.1.4 below discusses the anticipated growth distribution patterns further and the Regional Spatial Framework (RDF1) is of particular importance (Section 3.1.4.1 below). The Proposed Changes to the RSS published in March 2008 recommend substantial changes to the Panels recommended re-wording of RDF1.

Carrying Capacity

The Draft RSS proposed an aggregate increase of 450,000-522,000 dwellings over the plan period 2003-2021. The Panel Report raised a number of concerns about this level of growth, and in particular, the lack of testing of the impact of such an increase (Panel Report, para 6.38).

In particular the Panel was concerned as to whether water supply and sewage treatment infrastructure would have the capacity to support such a level of housing development. After much debate, it was concluded in the end that there was:

> *"no clear evidence that there would be insurmountable difficulties or that this level of development would cause unacceptable environmental damage" (Panel Report, para 6.41).*

However, the urgency of addressing water resource issues and wider sustainability issues has been reflected in the Panel's recommendations for substantial strengthening of the tone of Policy EM5 - the key policy for water management (recommendation subsequently accepted by the Secretary of State) and in an addition to Policy L4 relating to "the need to ensure that new dwellings will be served by adequate water supply and sewage management facilities" (recommendation subsequently accepted by the Secretary of State).

Flood Risk

The Panel noted that flood risk policy was an *"area of rapid change"* (Panel Report, para 8.33) and that since the draft RSS was proposed, "*two particularly important things had happened"*. The first was the fact that draft PPS25 was produced shortly before the draft RSS was published, and too late to be fully incorporated. The final version of PPS25 was published during the EiP (although the Companion Guide was not available until after the EiP).

The second was that the EA published a "Flood Risk Ranking for the North West", the first step towards production of a Regional Flood Risk Appraisal (RFRA) (as required by PPS25). The EA report examined current levels of flood risk in the region; and how development pressure for houses as identified within the draft RSS might increase risk. However the Risk Ranking document addressed tidal and fluvial flooding only, and did not consider other potential sources of flooding, as required by PPS 25. In the opinion of the Panel the Risk Ranking report *"was not sufficiently advanced to form the basis of a revision to RSS policies"*.

A key question which the Panel raised at the EiP as a consequence, was whether or not there was any evidence on flood risk which might pose a threat to any of the draft RSS proposals regarding the proposed broad locations for housing, employment, or transport infrastructure. By the conclusion of the EIP, the Panel was satisfied that there was no such evidence, and no need to alter the RSS proposals as a result.

The Panel did stress however, that it was important for local authorities to consider flood risk at an early stage as the RSS is not site specific (though it is District specific). At the Local Development Framework level, conflicts may arise in relation to particular allocations and proposals (Panel Report, para 8.39).

Climate Change

One of the key criticisms of the Draft RSS raised at the EIP is that it does not adequately address climate change. The EA were particularly concerned that the RSS does not prepare the region to deal with climate change consequences – in particular in relation to CO_2 emissions, water resources and flood risk. In relation to flood risk, the EA was concerned that:

> *"…the broad levels and locations of growth have not been considered in terms of the level of risk they currently face or will face over the lifetime of RSS and beyond as a result of climate change" (EA Submission Statement for the EIP).*

To complicate matters further, the draft PPS on climate change was issued half way through the EiP – after the debate which involved climate change had taken place. The Panel regarded this deficiency (i.e. failure to consider climate change adequately) as a serious flaw and felt that it was important to ensure that the whole of the Plan is suffused with the climate change imperative. The Panel also recommended a new policy DP8. The Regional Assembly has subsequently published its intention to undertake an early partial review of the RSS, which will include a review of the policies in light of climate change imperatives.

There was much discussion at the EiP about the development of the concept of "environmental capacity" or "environmental limits", as a policy tool, to which flood risk data would be a significant contributor. Scoping work has since been undertaken by the Regional Assembly.

A consideration of specific policies within the RSS, the Panel's responses and recommendations and the Secretary of States responses (published as Proposed Changes to the Draft RSS) is presented in Appendix C. This examines any subsequent implications for the SFRA in a series of tables.

Following the EiP, the North West Regional Assembly commissioned a number of additional studies, as a result of recommendations from the Panel, and on the basis of concerns raised by respondents at the EiP. Of particular importance to the SFRA is the **North West Environmental Capacity Scoping Study**, which was published in July 2007 by Entec UK Limited. This was a response to the debate regarding the relationship between RSS policies and environmental capacity issues, particularly in regard to water resources and housing numbers. The scoping study recommends three further studies which have particular implications for the SFRA, and which may require revisiting the findings of the SFRA in the future. The three studies which are recommended are:

- **A sub-regional study of climate change impacts on land management** - Using climate change as a reference point, understand how, through integrated land management, greater resilience and responsiveness can be established to meet likely climatic changes. Data on stocking rates, siltation of water courses, land cover, landscape appraisal and flood risk, for example, could inform the production of risk maps or sensitivity maps which illustrate potential vulnerability.

- **A regional appraisal of water-related capacity issues** - A comprehensive appraisal of the relationship between water supply, treatment and disposal and the likely level and spatial

distribution of development in the North West. Through an appraisal of water resource capacity, a framework for accommodating growth can be established - which fits with the water industry investment cycles, pays heed to emerging knowledge on matters such as flood risk and takes into consideration impacts on water-related biodiversity assets. Whilst consideration of water resources should not necessarily guide RSS policy *per se*, the influence over development phasing, consideration of 'down-stream' and cumulative impacts, and the need for indicators of climate change impacts and responses (water being key here), should be considerable. The authors considered that this work should be undertaken as a matter of urgency.

- **A local study of rural settlement form and function**
  This study is needed to identify what the principal environmental capacity issues are in relation to rural settlement planning and whether current planning policy takes account of these issues. The purpose of the study will be to identify what data sources are needed to establish a baseline against which capacity performance can be judged and what levels and types of development are likely to compromise environmental capacity in these environments.

Further work programmed by the Regional Assembly includes **Identifying Sub-regional Housing Market Areas in the North West** which was due to start in September 2007. This work should be informed by the SFRA and vice versa.

3.1.4 Anticipated Regional Development Patterns

3.1.4.1 The Pattern of Proposed Development

Draft RSS EiP - Panel Recommendations

Policy RDF1 Spatial Priorities is the cornerstone of the RSS. This policy sets out the spatial priorities for growth and development, investment and regeneration. Following the EiP of the Draft RSS and the panel recommendations, RDF1 states that Plans and Strategies in the North West are to support the concentration of most new development within the urban areas of the Regional Centres. This is to reflect their role as key economic drivers, to secure urban regeneration and to create a balanced network of urban centres throughout the region, to benefit and improve the environment and social circumstances.

The Draft RSS splits the sub-region geographically into three sectors

1. The Manchester City Region (MCR2), comprising "Inner Areas" and the "Regional Centre" that include parts of Manchester, Salford and Trafford Districts.

2. The Southern Part (MCR3) of the City Region, including the southern parts of Manchester and Trafford Councils and Stockport Council (within AGMA).

3. The Northern Part of the City Region (MCR4), including Bolton, Bury, Oldham, Rochdale, Tameside and Wigan Councils (within AGMA).

Proposed Changes to the RSS & Panel Recommendations

Not surprisingly, RDF1 has changed substantially since the Draft RSS was first published in January 2006. The Proposed Changes to the RSS, published in March 2008, make further changes to the wording recommended by the Panel in their report. The proposed new wording is as follows:

> In making provision for development, plans and strategies should accord with the following priorities, taking into account specific considerations set out in Sub Regional Chapters 10-14:
>
> - the first priority for growth and development should be the regional centres of Manchester and Liverpool;
> - the second priority should be the inner areas surrounding these regional centres. Emphasis should be placed on areas in need of regeneration and Housing Market Renewal Areas in particular;
> - the third priority for growth should be the following towns / cities: Altrincham, Ashton-under-Lyne, Barrow-in-Furness, Birkenhead, Blackburn, Blackpool, Bolton, Burnley, Bury, Carlisle, Chester, Crewe, Ellesmere Port, Lancaster, Macclesfield, Northwich, Oldham, Preston, Rochdale, Runcorn, St Helens, Skelmersdale, Southport, Stockport, Warrington, Widnes, Wigan, Workington/Whitehaven.
>
> As far as possible growth should be focussed in their centres and inner areas but development elsewhere may be acceptable if it satisfies other policies, notably DP1 to 9. Emphasis should be placed on areas in need of regeneration (particularly the Housing Market Renewal Areas).

The new wording has removed the Northern (MCR4) and Southern (MCR3) emphasis from the document. However, the main emphasis for development still follows the same principals and prioritisation as described in the RSS of developing within the Regional Centre, then the Inner Areas including HMRs and finally surrounding towns (Figure 3-1):

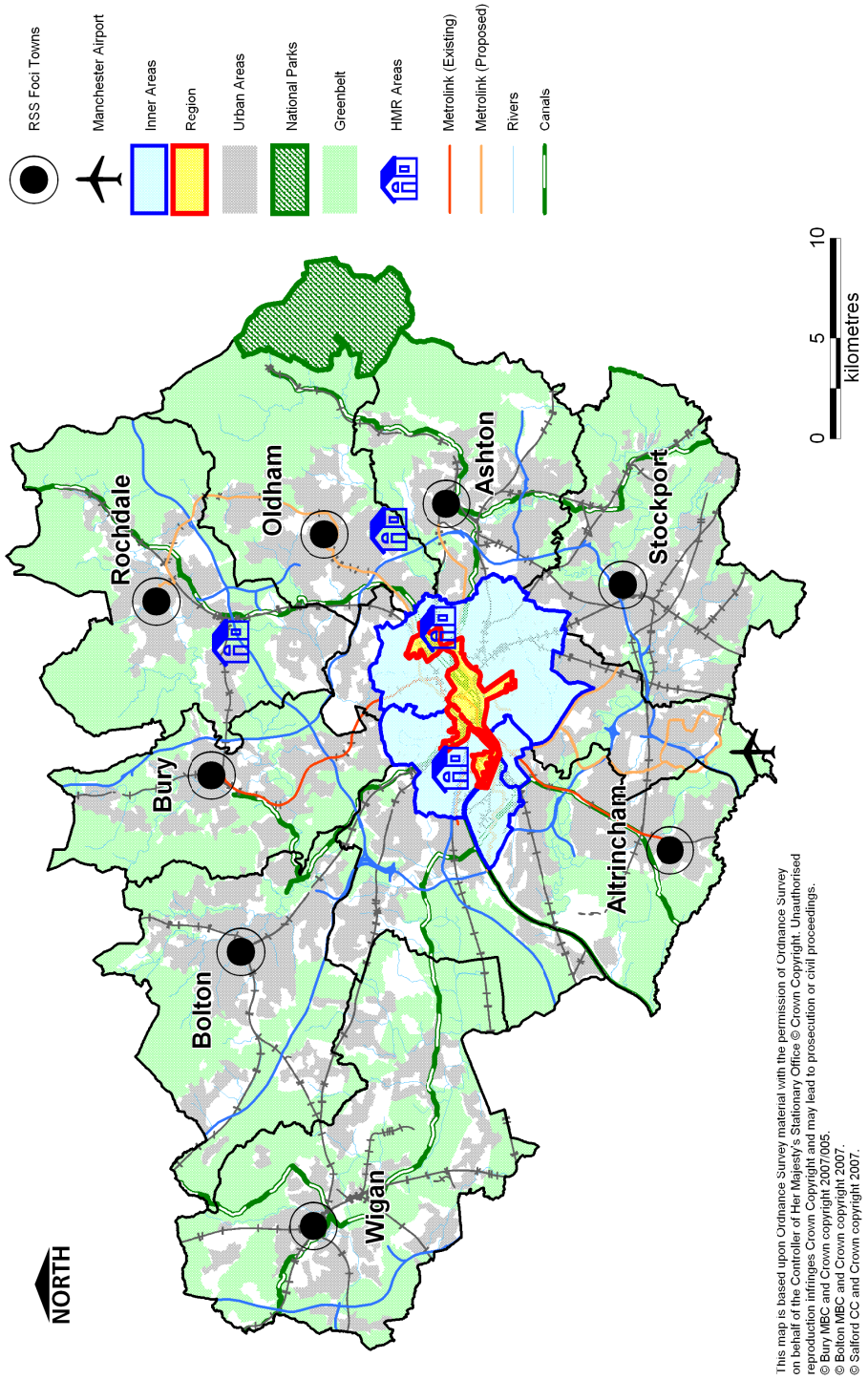


Figure 3-1: The Manchester City Region, extracted and amended from the NW Draft RSS and the Proposed Changes (March 2008)

3.1.4.2 The Quantum of Proposed Development

Draft RSS EiP - Panel Recommendations

Some concern was expressed at the EiP over the balance of development across the sub-region, particularly with the North-South divide across the AGMA councils. The concern was raised regarding the concentration of economic and mixed use development in southern areas, whilst housing appeared to be focused mainly in central and northern areas, thus leading to increased movement and commuting across the sub-region.

Following the production of the Draft RSS, the examination in public (EiP) and the Panel recommendations, the scale of the proposed growth within the sub-region has been defined and the published housing targets (March 2008) demonstrate the quantum of this development across all ten Districts (Table 3-1).

Table 3-1: Proposed RSS Housing and PDL Targets for AGMA sub-region (Table 9.1, RSS Panel Recommendations).

Council	Revised RSS Housing Target (Total housing provision, net of clearance replacement)	PDL Target (All figures are minimum targets)
Bolton	10,400	80%
Bury	9,000	80%
Manchester	63,000	90%
Oldham	5,200	80%
Rochdale	7,200	80%
Salford	28,800	90%
Stockport	8,100	80%
Tameside	13,500	80%
Trafford	10,400	80%
Wigan	17,600	80%

New Growth Point Increases

AGMA submitted an expression of interest to the Department for Communities and Local Government (DCLG) on 31st October 2007 for a new growth point covering the whole of the Greater Manchester sub-region.

This submission is made against a background of strong economic and employment growth over the past five years. Economic forecasts indicate that an additional 150,000 jobs will be created over the next fifteen years as the City Region increases its contribution to the national economy. In AGMA's Expression of Interest, there are proposals to further increase and accelerate provision in response to the Housing Green Paper.

On the basis of the proposals set out within the EoI, Greater Manchester's annual provision would further increase to at least 10,875 homes per annum. This represents a further increase over the level of housing proposed in the Draft RSS Panel Report, of 1,252 homes per annum or 13%, across Greater Manchester as a whole.

The EoI indicates that there will be additional growth in the number of homes initially in four districts; Bolton, Manchester, Salford and Trafford. The proposals will deliver housing growth in Greater Manchester which will be in excess of the ONS 2004 household projections for the sub region, which would require an average provision of 10,583 homes per annum.

Table 3-2 compares the current panel recommendations against the possible growth point figures.

Table 3-2: Comparison of Proposed RSS Housing Targets for AGMA sub-region (Table 9.1, RSS Panel Recommendations) with potential Growth Point increases.

	RSS Targets		Potential quantum of development based on New Growth Point Proposals (Total housing provision, net of clearance replacement)			
	RSS Panel Recommended Targets	Mean Annual Increase	2003-2008	2008-2016	2016-2021	Increased Target inc. NGP
Bolton	10,400	578	2890	**5552***	2890	**11332***
Bury	9,000	500	2500	4000	2500	9000
Oldham	5,200	289	1445	2312	1445	5202
Manchester	63,000	3,500	17500	**33600***	17500	**68600***
Rochdale	7,200	400	2000	3200	2000	7200
Salford	28,800	1,600	8000	**15360***	8000	**31360***
Stockport	8,100	450	2250	3600	2250	8100
Tameside	13,500	750	3750	6000	3750	13500
Trafford	10,400	578	2890	**5552***	2890	**11332***
Wigan	17,600	978	4890	7824	4890	17604

** Growth point increases for Manchester CC, Salford CC, Trafford MBC and Bolton MBC. As of May 2008, proposals were for an additional 20% increase on mean annual increase figures from the RSS Panel Recommendations for the 8 year period from 2008-2016. This equates to 4200pa for Manchester CC, 1920pa for Salford CC, 694pa for Bolton MBC and 694pa for Trafford MBC. Figures in **bold** indicate where possible growth point increases have been applied.*

The scale of development can also be compared in a graphical form to demonstrate both the proportionality and distribution of development. A three dimensional map was produced to enable the scale, distribution and proportionality of proposed development to be displayed together and to allow a quick appreciation of the current targets and the potential growth point increases (Figure 3-2).

This exercise has highlighted the extent and scale of development within the Manchester City Region and informs the strategic overview of flood risk by allowing comparisons to be made between proposed development and areas at risk of flooding.

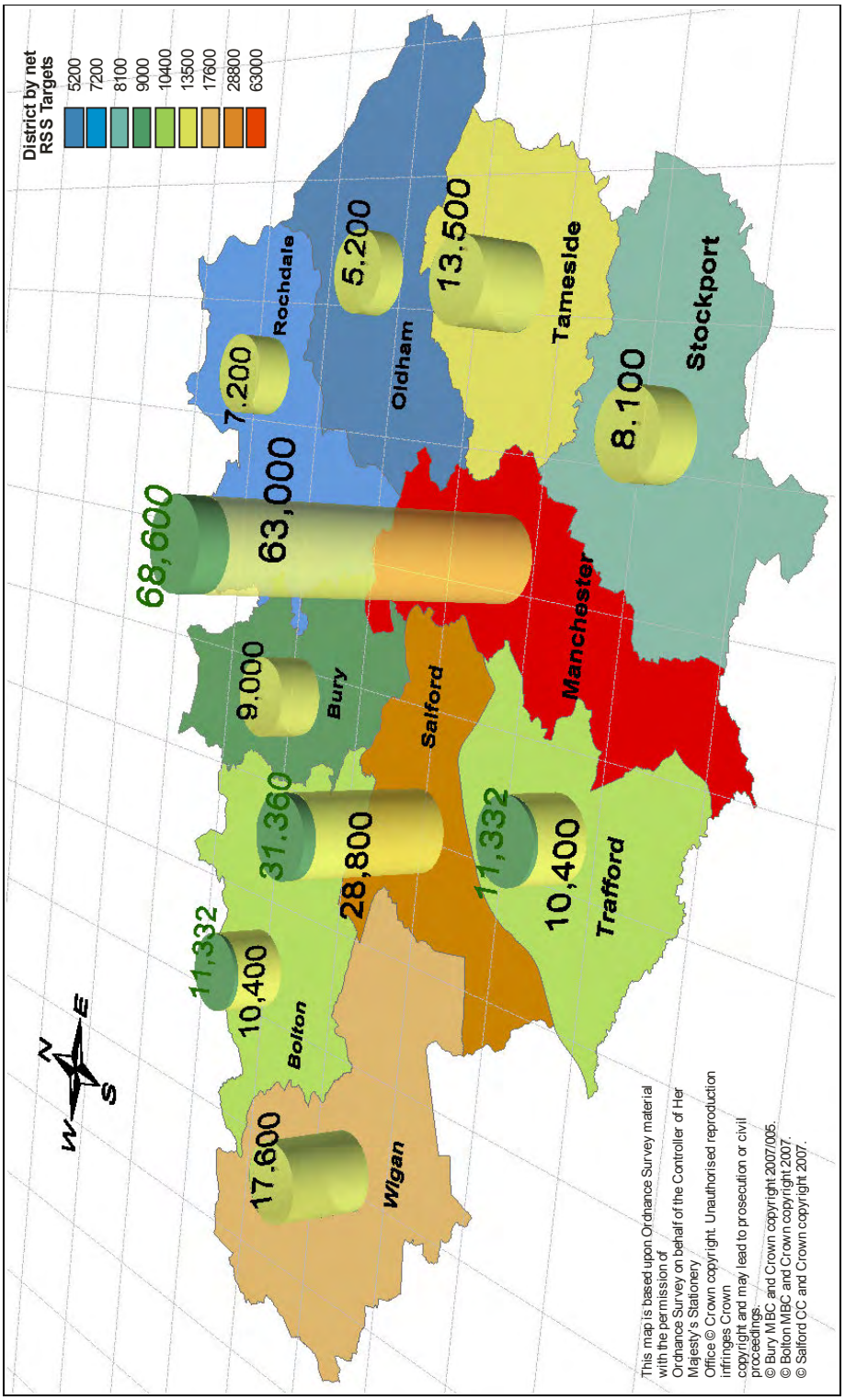


Figure 3-2: RSS Housing Targets displayed in a 3D map (yellow columns). Increases for potential New Growth Points are also highlighted (Green Columns)

3.1.5 Local Policy

A Local Flood Risk Policy review is presented in detail in Appendix B with a series of supporting tables in Appendix C. The review centres on those flood risk policies that can be found within the existing Unitary Development Plans of each of the AGMA authorities. In each case these policies predate PPS25 and therefore will not cover the full extent of the guidance; neither are they likely to be in general conformity to the Regional Spatial Strategy as required under new regulations for statutory development plans. This policy review highlights the need to realign local policy on flood risk with emerging regional policy.

Many of these UDP policies are however, still applicable in terms of assessing planning applications. Under provisions introduced by the Planning and Compulsory Purchase Act 2004, local policies are "saved" until such time as they are replaced by policies in the new Local Development Framework for each authority. They are therefore a strong material consideration, alongside allocations and policy initiatives that have emerged since 'saving' of the UDP policy proposals. The Sub-Regional Strategic Flood Risk Assessment is intended to inform the process of preparing new local policies in the LDF context, by providing a strong evidence base for new spatial policies.

Emerging policy must be responsive to changing social and economic priorities and the key environmental concerns and objectives within new national policy guidance. This includes for example, PPS25 and other overarching policy, in particular guidance on delivering sustainable development and climate change. Local policy should also take into account, and be in general conformity with the strategic direction for sustainable economic growth within the region, as outlined in the emerging Regional Spatial Strategy. The purpose of the policy review is to identify and to assess the current position for each authority, and the key drivers of local spatial policy.

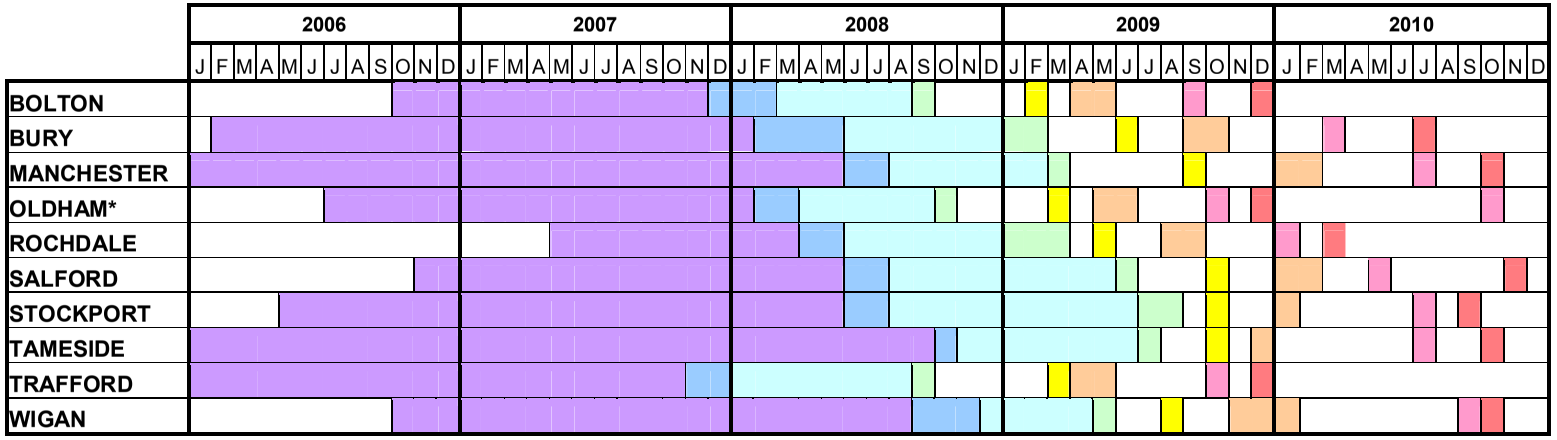
3.1.6 Local Development Frameworks

In order to understand how the SFRA will feed into the LDF for each council, it is helpful to highlight the individual Council LDF programmes. One to one meetings with each council identified probable LDF timetables, in particular in relation to Core Strategies (see Table 3-3). The SFRA directly informs aspects of the LDF, particularly land allocation, and therefore it is important to compare timetables so that the consequences of the SFRA (for example the Sequential Test) can be considered.

The Greater Manchester Authorities are all at the first stage of the process for their Core strategies – the Issues and Options stage; gathering and building evidence bases, and undertaking scoping reports for Sustainability Appraisal. This is particularly opportune as the concept of "front-loading" the production of Local Development Frameworks would suggest that this is the most appropriate stage for the Sub-Regional SFRA to inform strategic land-use planning.

The findings of the Sub-Regional SFRA can be taken into account in drawing up spatial issues and options for land use development within the Greater Manchester Districts, and in the public consultation which informs this. Core Strategies informed by the Sub-Regional SFRA, can then form a solid foundation on which each District can use to inform specific spatial decisions, particularly through Site Allocations DPDs. It has been assumed that Site Allocations DPDs will be prepared following the successful progression of Core Strategies, at least to Preferred Options or Submission Stage.

Table 3-3: LDF Core Strategy progress & Timetable (based on LDS documents available in May 2008)



1	2	3	4	5	6	7	8
Start preparation (Issues and Options sustainability appraisal)	Publish Preferred Options & Sustainability Appraisal (invited formal consultation)	Consideration of Representation / report to Council	Submission of DPD and supporting documents to Inspector Formal Representations invited	Pre-Examination meeting	Independent Examination	Receipt of Binding Report	Adoption

*Oldham are not preparing and publishing a Preferred Options report so Stage 2 in their timetable represents the Issues & Options Consultation, following which the Submission Draft Core Strategy is prepared.

Note: Local Development Schemes may change to take account of the new PPS12 (2008).

4 Flood Risk

The Greater Manchester sub-region consists of a complex hydrological network that interlinks all of the councils (Figure A-1 in Appendix A). The hydrology of the sub-region is affected not only by natural features such as topography, watercourses and geology, but also by artificial influences such as canals, reservoirs and the built environment. As a result, the sub-region also has a complex mix of varying and interlinked flood sources and associated risks. The way the hydrology of the sub-region is influenced and managed also plays an important role to the type and nature of flooding. Therefore, it is useful to summarise the hydrology of the sub-region and the flood risk policies currently (or shortly to be) in use. The aim of these reviews is to provide a better understanding of the nature and type of flood sources applicable to the sub-region.

4.1 Hydrological Summary

The main river catchments and sub-catchments affecting the sub-region are:

- The River Irwell
- River Douglas
- The River Mersey
- Glaze Brook

All of these catchments, except for the Douglas, drain into the Manchester Ship Canal, which then flows towards the Mersey Estuary through Warrington. Figure 4-1 shows the distribution of river catchments by council across the Greater Manchester sub-region and is designed to highlight which river catchments are most relevant to which councils. Figure 4-2 highlights the overall distribution of river catchments. It is clear from these figures that the Mersey and Irwell catchments dominate the hydrological coverage across Greater Manchester.

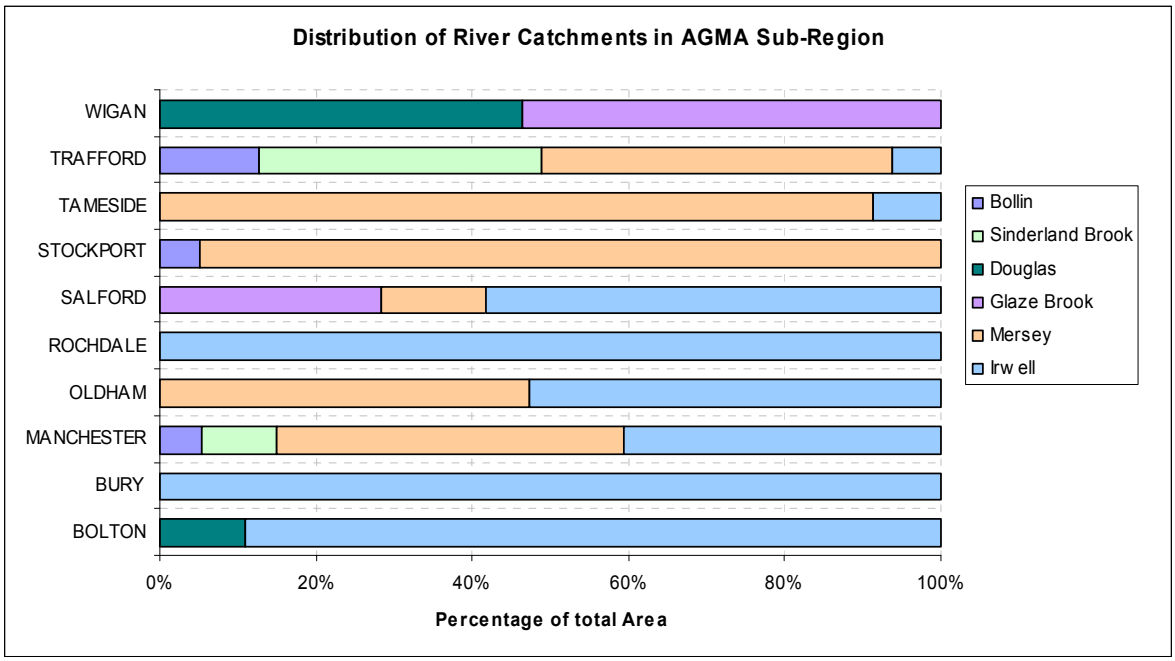


Figure 4-1: Distribution of River Catchments in AGMA Districts

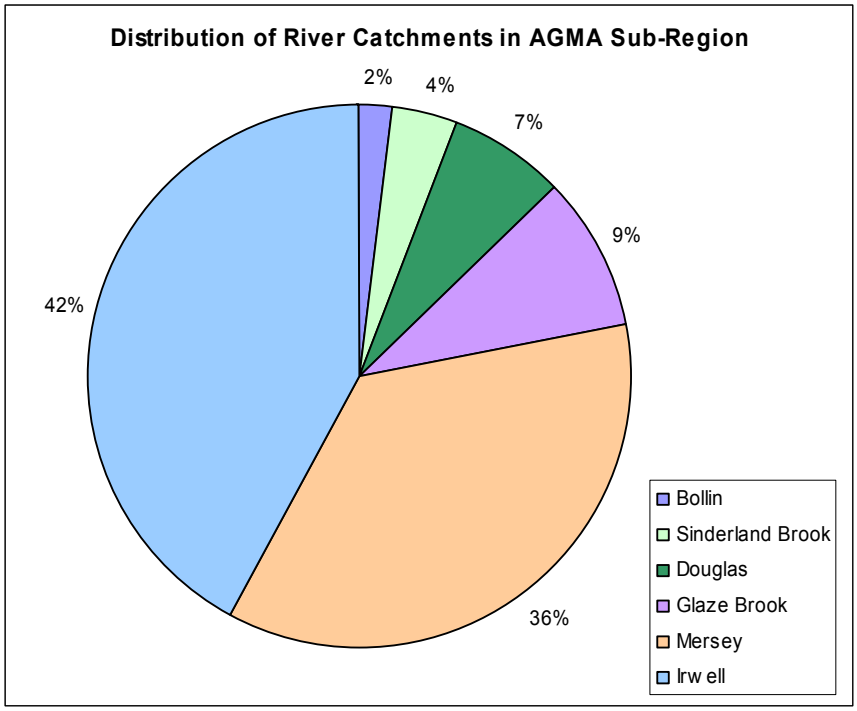


Figure 4-2: Distribution of River Catchments in the Greater Manchester Sub-Region

4.1.1 River Irwell & Tributaries

The Irwell Catchment extends from the moors above Bacup (Rossendale) to the Manchester Ship Canal in the centre of Manchester. The catchment has an area of approximately 751 km^2 with 546 km^2 covering the Greater Manchester sub-region – making up 42% of the AGMA area. The Irwell and its tributaries tend to respond quickly to rainfall due to the narrow, steep valleys in the upper catchment and the limited permeability of the geology, both of which facilitate rapid runoff[12].

The geology of the catchment contributes to high rates of run-off. In general, the underlying solid geology comprises Lower Coal Measures overlying Millstone Grit, both from the Carboniferous era. These are both classified as minor aquifers, meaning they will hold water, but only in relatively small amounts. Superficial deposits comprise thick peat in the upper reaches, and glacial boulder clay (diamicton) and glacial sand and gravel in the lower parts. The sand and gravel are also classified as a minor aquifer, whilst the boulder clay is a non-aquifer (Figure A-2, A-3a, A-3b and A-4 in Appendix A).

In the upper catchment, flood risk tends to be predominantly due to surface water flooding as a result of high runoff rates and less permeable superficial geology. However, fluvial flooding is also a risk with recorded incidents in Ramsbottom and areas upstream in Rossendale. In the middle catchment, the main flood risk is presented by fluvial flooding following heavy and prolonged rainfall. The lower catchment tends to suffer more serious fluvial flooding following widespread heavy rain and prolonged periods of wet weather. Being at the downstream end of the catchment and lying relatively low, flood waters here can be fast flowing with a depth of up to 2m[12].

[12] River Irwell Catchment Flood Management Plan, December 2006, Environment Agency

Manchester City Centre tends to also be vulnerable to short term intense rainfall as the tributaries of the Medlock and Irk are smaller and flashier. A search of historic flooding records has revealed that Fallowfield has experienced repeated flash flooding (see Appendix B).

The major flood risk areas in the Irwell catchment are in Salford, where 12,477 properties are at risk. Other areas affected by flooding are Rochdale, Littleborough, Ramsbottom and Radcliffe.

The main watercourses in the catchment are listed in Table 4-1 together with the urban areas and the Districts that they affect.

Table 4-1: Watercourses and the Districts and Areas affected by flooding within the Irwell Catchment[12]

Watercourse	District	Urban area at Risk
Irwell	Bury, Bolton, Salford, Manchester	Bury, Salford, Manchester
Spodden	Rochdale	Rochdale
Roch	Rochdale, Bury	Rochdale, Bury
Beal	Oldham	Shaw
Irk	Oldham, Rochdale, Manchester	Royton, Manchester
Medlock	Oldham, Tameside, Manchester	Manchester, Failsworth
Croal	Bolton	Bolton, Farnworth, Prestwich
Manchester Ship Canal	Salford, Trafford, Manchester	Salford, Manchester, Irlam

Given the urban extent and the industrial heritage of the settlements within the Irwell Catchment, there are numerous artificial waterways, canals, reservoirs and structures that potentially have an impact on flooding within the catchment. The main canals in the catchment are the Manchester Bury & Bolton Canal, the Rochdale Canal, the Bridgewater Canal and the Manchester Ship Canal whilst there are numerous reservoirs spread mainly across the upper catchment.

4.1.2 Mersey & Tributaries

The Mersey catchment has a total catchment area of approximately 1,050 km^2. Of this, approximately 540 km^2 covers the Greater Manchester sub-region, which equates to approximately 36% of the total AGMA area. The watercourses of the Upper Mersey rise in the Derbyshire Dales and High Peak Districts and pass through Oldham, Tameside, Stockport, Trafford and Manchester before draining into Manchester Ship Canal (Figure A-1, Appendix A).

Like the Irwell Catchment, the watercourses in the upper catchment areas of the Mersey tend to respond rapidly to rainfall events. This is due to the steep topography and the relatively impermeable geology of the uplands in the east of the catchment consisting primarily of Pennine Gritstones (Figure A-2, A-3a, A-3b and A-4 in Appendix A). As the rivers flow downstream and towards the west of the catchment, the topography flattens out and the geology consists of glacial till underlain by Carboniferous coal measures and limestones[13].

[13] Upper Mersey Catchment Flood Management Plan, February 2007, Environment Agency

The main river watercourses in the Upper Mersey catchment are:

- River Mersey
- River Tame
- River Goyt
- River Etherow

The principal towns are Stockport, Ashton, Hyde and Denton on the River Mersey, Glossop on Glossop Brook, Stalybridge on the River Tame and Whaley Bridge and Marple on the River Goyt.

The main river flood risks are in urban areas in the upper sections of catchments. These catchments are typically steep sided and flashy making them susceptible to high intensity and short duration events. The lower catchment areas tend to be affected more by longer duration storm events, particularly the Mersey with its large catchment area.

The main flood risk sites are associated with the Mersey, Tame, Goyt and Etherow, which flow through urban areas such as Stockport, and have properties located close to the watercourse. Key flood sites in Greater Manchester itself include: Northenden, Sale, Didsbury/Chorlton, Stockport at the confluence of Tame and Goyt, Micker Brook in Cheadle, Gatley Brook in Gatley and River Mersey at Flixton.

Again, as with the Irwell Catchment, the Upper Mersey contains numerous artificial waterways, canals, reservoirs and structures that potentially have an impact on flooding within the catchment. The main canals within the catchment are the Ashton Canal, the Rochdale Canal, the Huddersfield Narrow, the Peak Forest Canal, the Bridgewater Canal and the Manchester Ship Canal.

The main watercourses in the catchment are listed together with the urban areas and the Districts that they affect.

Table 4-2: Watercourses and the Districts and Areas affected by flooding within the Mersey Catchment[13]

Watercourse	District	Urban Area at Risk
Etherow	Tameside, Stockport	Hollingworth, Broadbottom
Goyt	Stockport	Stockport, Romley Marple Bridge
Mersey	Stockport, Manchester Trafford	Stockport, Didsbury, Northenden, Stretford, Urmston, Sale, Cheadle
Micker Brook	Stockport	Cheadle
Sett	N/A- Stockport	Hayfield
Tame	Oldham Stockport	Delph, Upper Mill, Mossley, Stalybridge, Portwood
Baguley Brook	Manchester, Trafford	Sale
Manchester Ship Canal	Trafford, Salford, Manchester	Unknown

4.1.3 The River Bollin

The River Bollin has a catchment area of approximately 260km^2 and flows in an east west direction to the south of the AGMA area, predominantly through Macclesfield and Congleton district councils. The catchment is predominantly rural with the urban areas of Wilmslow, Bowdon, Bollington, Macclesfield and Alderley Edge being the main settlements.

The River Bollin rises in the foothills of the Pennines within Macclesfield Forest and flows through towns including Macclesfield, Bowdon and Dunham and, some 50km later joins the Mersey and Manchester Ship Canal at Lymm. The River Dean is a tributary of the Bollin and flows through mainly rural areas joining with the River Bollin just south of Styal.

As a result, most of the Bollin catchment is outside of the AGMA sub-region and only affects 2% of the total AGMA area covering the southern fringes of Stockport, Manchester and Trafford councils. In fact, the River Dean forms part of the administrative boundary between Macclesfield and Stockport. Similarly, the River Bollin forms part of the boundary between Macclesfield and Trafford.

The main areas within the AGMA councils at risk from possible flooding along the Bollin are along the Trafford boundary with Macclesfield, in particular Hale (Table 4-3).

Table 4-3: Watercourses and the Districts and Areas affected by flooding within the River Bollin Catchment

Watercourse	AGMA District affected	Urban Area at Risk in AGMA sub-region
Bollin	Trafford & Manchester	Hale and Manchester Airport
Dean	Stockport	No significant urban areas at risk in AGMA

4.1.4 Sinderland Brook

Sinderland Brook has a comparatively small catchment with an area of approximately 49km^2. The Brook flows from its headwaters near Wythenshawe in Manchester in the east, through Altrincham (Broadheath) where its main tributary, Timperley Brook joins, to the confluence with the Manchester Ship Canal at Partington in Trafford to the west (Table 4-4). Compared to the other catchments within the AGMA sub-region, it is relatively flat, with a level of 84mAOD at the headwaters and 13mAOD at the confluence with the Ship Canal[14]. Sinderland Brook is a partly 'sewered out' catchment with many culverted reaches which carry an associated flood risk.

The Sinderland Brook catchment is situated entirely within the administrative areas of Manchester and Trafford councils and, as a result, is almost 60% urbanised. The main urban areas are located in the eastern half of the catchment and consist primarily of Wythenshaw, Altrincham and Sale. To the east of the catchment, landuse is relatively rural.

Table 4-4: Watercourses and the Districts and Areas affected by flooding within the Sinderland Brook Catchment

Watercourse	AGMA District affected	Urban Area at Risk in AGMA sub-region
Sinderland/Timperley Brook	Trafford	Sale, Brooklands Broadheath

[14] The National River Flow Archive, CEH 2007. http://www.ceh.ac.uk/data/nrfa/index.html

4.1.5 The River Douglas & Tributaries

The headwaters of the River Douglas itself rise on Rivington Moor at a height of around 440 m AOD at Winter Hill within the District of Chorley. A series of large reservoirs, known as the Rivington Reservoir Complex, are situated in the upper catchment, which capture the runoff from moorland areas of the Southern Pennines. The Rivington reservoirs also form the headwaters of the River Yarrow[15].

The River Douglas continues to flow southwest into Bolton MBC in a relatively steep narrow valley through Horwich, underneath the Worthington Reservoir (through a culvert) and into Wigan. Downstream of Wigan, the Douglas flows northwest until it reaches the Ribble Estuary. Therefore, of the 460 km^2 that makes up the Douglas catchment, approximately 91 km^2 of the catchment intersects with the Greater Manchester sub-region – covering approximately 7% of the total AGMA area (Figure A-1, Appendix A).

Peat deposits dominate the higher ground of the Rivington Moors in the east of the Douglas catchment intersected with areas of rock outcrop around parts of Wigan. The geology of the area, the urban extent and the steep topography leads to a higher susceptibility to surface water flooding as a result of rapid runoff in the Upper Douglas catchment and records show that Wigan has suffered from such events in the past.

However, the main flood risk in this area is from rivers overtopping their banks following prolonged rainfall and Wigan is particularly susceptible to flooding. Sedimentation can be a problem in Wigan near the bus station - primarily due to abrupt change in gradient of the long profile. Flooding related to sedimentation is found upstream of culverts and weirs and blockages from urban debris[15].

In addition to main river flooding, smaller watercourses and tributaries also pose a significant flood risk – especially in Wigan. The risk is increased when flood peaks coincide at the confluence of the Douglas and it tributaries. The Poolstock area has suffered flooding from tributaries in the past.

Table 4-5: Watercourses and the Districts and Areas affected by flooding within the Douglas Catchment[15]

Watercourse	District	Urban area at Risk
Douglas	Wigan	Wigan
Hawkley Brook	Wigan	Wigan
Ince Brook	Wigan	Wigan, Ince in Makerfield
Smithy Brook	Wigan	Wigan
Calico Brook	Wigan	Shevington, Shevington Vale
Worthington Lakes	Wigan, Bolton	Standish
Pearl Brook	Bolton	Horwich
Rivington Reservoirs	Bolton	Horwich

[15] River Douglas Catchment Flood Management Plan, March 2007, Environment Agency

As discussed above, the hydrology of Upper Douglas is heavily affected by artificial influences such as the Worthington Reservoir Complex and some property flooding has occurred immediately downstream of the Rivington reservoirs following emergency releases[15]. The Douglas is culverted beneath some of the reservoirs thereby increasing the risk of flooding due to blockage. The Leeds and Liverpool Canal also runs through the catchment. The Douglas flows underneath the canal via the Green St Siphon in Wigan town centre. The Douglas through Wigan is made up of a large proportion of high walled concrete channels that confine flows but increases the potential risk of flooding as a result of blockage.

4.1.6 Glaze Brook & Tributaries

The final 9% of the Manchester sub-region is covered by the Glaze Brook catchment (Figure A-1, Appendix A). Almost the whole of the Glaze Brook catchment is contained within the Wigan MBC and Salford CC administrative boundaries, Bolton District is also affected at Westhoughton (Figure 4-1). The headwaters are immediately to the south-east of Wigan with the Brook flowing towards the south-east and discharging into the Manchester Ship Canal.

The main flood risk in the Glaze Brook Catchment is from rivers overtopping their banks following prolonged rainfall, or from intense rainfall exceeding the drainage and channel capacity. This is particularly true in urban areas in steeper parts of the catchment. Flooding is currently considered to be an issue in Tyldesley, Leigh, Atherton, Westhoughton and Ashton -in-Makerfield[16].

There are no known groundwater flooding incidents in the catchment however, sewer flooding has been a problem in Worsley and Golbourne, Atherton, Astley, Leigh, Hindley, Westhoughton and Abram.

Table 4-6: Watercourses and the Districts and Areas affected by flooding within the Glaze Brook Catchment[16]

Watercourse	District	Urban area at Risk
Collier Brook, Westleigh Brook	Wigan	Leigh
Tyldesley	Wigan	Tyldesley
Glaze Brook	Wigan, Bolton, Salford	Glazebury, Atherton, Westhoughton, Cadishead
Carr Brook	Wigan	Lowton
Pennington Brook	Wigan	Lately Common
Hey Brook	Wigan	Abram
Borsdane Brook	Wigan	Hindley
Shaw Brook	Salford	Worsley Moss
Brookdale Brook	Wigan	Bickershaw
Rindle Brook	Wigan	Platt Bridge
Pen Leach	Wigan	Bedford and Lilford
Millingford Brook	Wigan	Ashton in Makerfield

The Bridgewater Canal, Leigh Branch and the Manchester Ship Canal are located within the catchment. There are numerous ordinary and critical ordinary watercourses (COWs) located within the catchment and records exist showing that flooding has been associated with them in the past, especially where there is an interaction with structures, such as culverts and bridges.

[16] Mersey Estuary Catchment Flood Management Plan, March 2007, Environment Agency

Flood Defences and flood control structures exist at the following locations:

- Lilford Park Storage Basin
- Bedford Pumping station
- Pennington Pumping station

4.2 Flood Risk Policy Review

In addition to the Flood Risk and Planning Policy review presented in Section 3.1, there are two other important sources of flood risk policy that are applicable to the Greater Manchester Sub-Region. These are the policies presented in the CFMPs and those presented in the existing Salford SFRA.

4.2.1 CFMPs

A CFMP is a high-level strategic plan which is used to identify and agree long-term policies for sustainable flood risk management for individual river catchments. CFMPs undertake flood risk assessment to identify the causes, size and location of flood risk throughout the catchment, and the various influences that can make a difference to the probability and consequences of flooding. This enables the effect of potential changes in the catchment on flood risk to be identified. Potential changes may include, for example:

- development and land use change, such as new development or significant changes in the developed environment;
- changes in the rural landscape, including large scale changes in land management;
- loss of, or potential threat to, wildlife habitats or biodiversity;
- climate change.

Each of these potential sources of change can be influenced by land use planning policy – for example, a changing policy approach towards greenbelt protection or the loss of wildlife habitat, or the allocation of large greenfield sites for housing development.

Flood risk management looks at the probability of a flood occurring, and the impact it would have if it did occur. Flood risk management also has a spatial planning element, in that it involves decision on when, where and how to store or convey flood waters, to minimise the risks to people, property and the environment. CFMPs identify broad, long term (50-100 years) policies for sustainable flood risk management in the context of a particular catchment. The planning period is therefore considerably longer than the period typically considered to be “long-term” in land-use planning policy terms – which is usually 10 to 15 years, possibly 20 at the most. This potential conflict in planning timeframes should be highlighted as a change to land-use policy can occur in a much shorter period of time than the CFMP may account for. There is also a potential conflict in that catchment boundaries do not necessarily relate to local planning authority boundaries, and land use policy approaches may vary from authority to authority, increasing the complexity for flood risk management decisions across the catchment.

Catchment Flood Management Plans aim, amongst other objectives, to inform and support planning policies, statutory land use plans and implementation of the Water Framework Directive, so that future development in the catchment is sustainable in terms of flood risk. Awareness of the

role of CFMPs among land-use planners is however in its infancy as these plans, along with SFRAs, are a relatively new requirement.

Preparing CFMP's involves carrying out a strategic assessment of current and future flood risk from all sources (not just fluvial or coastal), understanding both the likelihood and impact of the risk and the effect of current measures to reduce that risk. The scale of risk is broadly measured in economic, social and environmental terms. The Plans identify opportunities and constraints within the catchment to reduce flood risk through strategic changes or responses, such as changes in climate, urban development, land use, land management practices and/or the flood defence infrastructure and waterways.

The CFMP's policies, which are identified for each individual "policy unit" (a policy unit relates to a specific geographical area) establish whether action should be taken to increase, decrease or maintain the current scale of flood risk. The CFMP does not identify specific ways of managing flood risk, which are the subject of subsequent, more detailed studies. A single policy is applied to each policy unit. Six policy options exist and may be applied (Table 4-7).

Table 4-7: Generic CFMP Policies

Option	Policy
1)	No active intervention (including flood warning and maintenance), continue to monitor and advise
2)	Reduce existing flood risk management actions (accepting that flood risk will increase with time)
3)	Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline)
4)	Take further action to sustain the current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change, and climate change)
5)	Take further action to reduce flood risk (now and/or in the future)
6)	Take action to increase the frequency of flooding (where appropriate) to deliver benefits locally or elsewhere, (which may constitute an overall flood risk reduction, e.g. for habitat inundation)

A number of actions may be identified for each policy unit, in order to achieve the specified policy approach. For example, one of the land-use planning responses in the Mersey Estuary Catchment Flood Management Plan is: *"Development Control advice on methods to reduce run-off and implementation of Sustainable Urban Drainage Systems (SuDS) in all new developments"*. It is expected that CFMPs will be used by regional and local government authorities to inform their spatial planning activities, sustainability appraisal/SEAs and emergency planning.

Four CFMPs have been produced which are relevant to the SFRA:

- Pilot River Irwell CFMP – December 2006
- Draft Upper Mersey CFMP – February 2007
- Draft Mersey Estuary CFMP – March 2007
- Draft River Douglas CFMP – March 2007

These are in varying stages of preparation and have been issued very recently. Consequently, the outcomes and conclusions for the draft CFMPs may change. Also, it is unlikely that their implications have been fully taken into account in current development plan documents. Close liaison with the EA should be maintained to ensure that when final versions of the CFMPs are published, the implications of each can be properly assessed with regards to the SFRA. The importance of CFMPs for land-use planning and particularly sites allocations planning, is an important message that needs to be conveyed to those responsible for preparing Local Development Frameworks.

At present, CFMPs can be looked on as "back-door" plans, which hold statutory weight in planning decisions, but which in terms of the preparation and detailed contents of the plans, are not subject to scrutiny through the planning process. Fortunately however, preparation of Local Development Documents in the Greater Manchester area are predominantly in their infancy, and therefore the opportunity exists to incorporate the policy directives of the CFMPs, through the SFRA, into strategic land use allocations and policy planning.

The policies relevant to the Greater Manchester sub-region are summarised in Table 4-8, Table 4-9, Table 4-10 and Table 4-11. As is expected in densely urbanised and populated areas, the majority of CFMP policies relevant to the AGMA sub-region suggest the current level of flood risk management is either maintained or increased in the future. 35% of the suggested CFMP policies for the Greater Manchester Sub-Region fall under generic policy 4 and likewise 5. Of the remaining policies, 17% fall under policy 6, 8% under policy 3, 4% under policy 2 and only 1% under Policy 1 (Figure 4-3 and Figure 4-4).

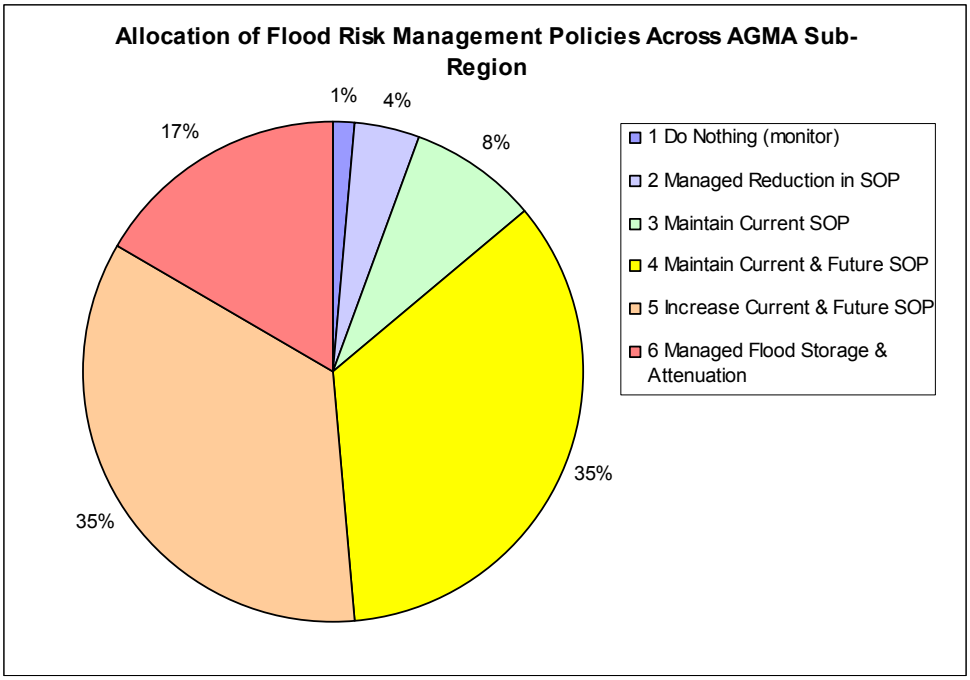


Figure 4-3: Distribution of suggested CFMP policies in AGMA Sub-Region

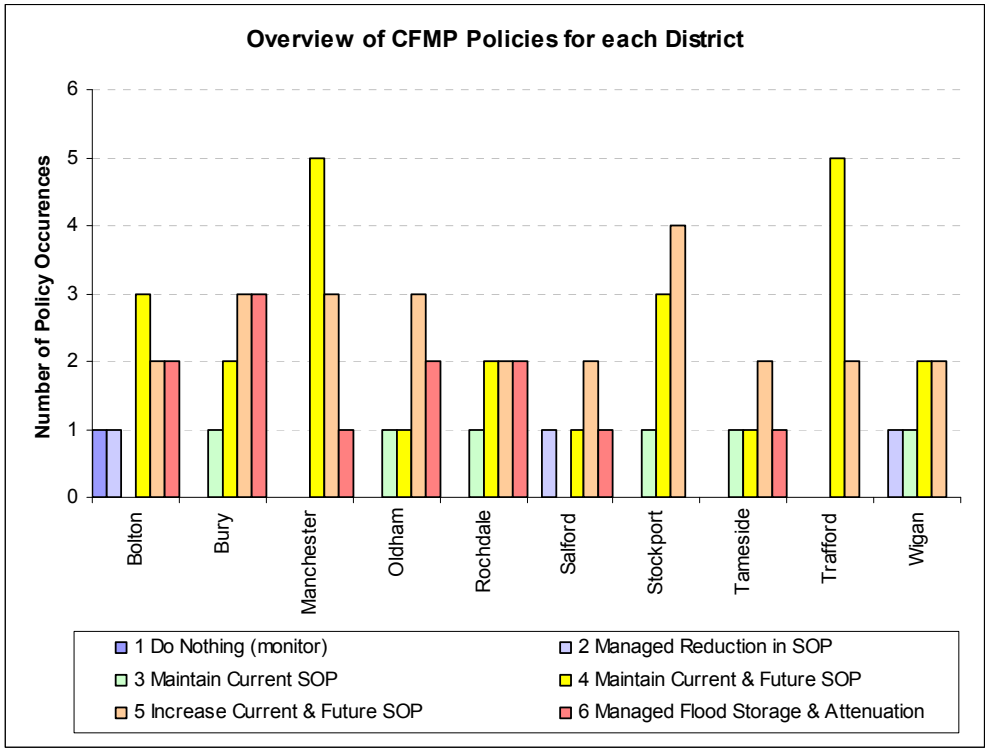


Figure 4-4: Distribution of suggested CFMP policies across AGMA Districts

Table 4-8: River Irwell CFMP Policies.

	Policy Unit	Policy Option	District
Pilot River Irwell CFMP	1: Manchester to Irlam (MSC)	4	Salford, Trafford, Manchester
	2: Manchester city centre (Irwell)	4 & 5	Manchester, Trafford, Salford
	3. Salford flood risk area (Irwell)	5	Salford
	4. Kearsley to Kersal (Irwell)	6	Bury, Bolton, Salford
	5. Radcliffe Flood risk area (Irwell)	5	Bury
	6. Bury (Irwell)	4	Bury
	7: Ramsbottom (Irwell)	4	Bury
	8. Rossendale valley (Irwell)	5	Bury, Rochdale
	9. Rural Rossendale (Irwell)	6	Bury, Rochdale
	10: Swinton and Eccles	5	Salford, Bolton

Table 4-8: River Irwell CFMP Policies. (continued)

	Policy Unit	Policy Option	District
Pilot River Irwell CFMP	11.Bradford and Deansgate (Medlock)	5	Manchester, Tameside
	12:South Oldham to Droylsden (Medlock)	6	Oldham, Manchester, Tameside
	13:Middleton and Chadderton (Irk)	5	Bury, Rochdale, Oldham
	14:North Oldham (Irk)	4	Oldham, Rochdale
	15: Bolton (Croal)	4 & 5	Bolton
	16:Rural Croal	6	Bolton, Bury
	17:Heywood and Whitefield (Roch)	3	Rochdale, Bury
	18: Rochdale and Little District (Roch)	4	Rochdale
	19: Whitworth, Shaw and Milnrow (Roch)	5	Oldham
	20.Rural Roch	6	Rochdale, Oldham

Table 4-9:Draft Upper Mersey CFMP Policies

	Policy Unit	Policy option	District
Draft Upper Mersey CFMP	PU1 Peak District	3	High Peak
	PU2 Bollin	4	Trafford, Manchester, Stockport
	PU3 Tame	5	Oldham, Tameside, Stockport
	PU4 Mersey	5	Stockport, Manchester, Trafford
	PU5 Upper Sinderland	4	Manchester, Trafford
	PU6 Goyt	5	Stockport
	PU7 Etherow	3	Tameside, Stockport
	PU8 Outliers	4	Stockport, Tameside, Manchester, Trafford

Table 4-10: Draft Mersey Estuary CFMP Policies

	Policy Unit	Policy option	District
Draft Mersey Estuary CFMP	1: Glaze	2	Wigan, Bolton, Salford
	2: Leigh	5	Wigan
	3: St Helens (Ashton in Makerfield)	3	Wigan

Table 4-11: Draft River Douglas CFMP Policies

	Policy Unit	Policy option	District
Draft River Douglas CFMP	1: Rivington Reservoir and catchment	1	Bolton
	2: Fluvial River Douglas and its tributaries	4	Wigan/Bolton
	5: Built up areas	4	Wigan/Bolton
	7: Wigan, Croston and Appley Bridge	5	Wigan

4.2.2 Salford SFRA

The Salford City SFRA was completed in November 2005 and adhered to the requirements of PPG25. As part of the sub-regional SFRA, a review of the Salford District Level SFRA was undertaken to contribute to the flood risk information and to determine how relevant the SFRA is to the more recent PPS25 and whether additional work may be required.

Overall the SFRA represents a comprehensive overview of flood risk across the District. Detailed 2-Dimensional Modelling was undertaken at sites across the District to determine accurate flood inundation figures (velocity, depth and direction of flow) for some of the principal floodplains of the River Irwell, most notably the Lower Broughton Area.

There are a number of key issues that PPS25 introduced that are not addressed in the Salford SFRA. One of these is Flood Zone 3b (Functional Floodplain). Under PPG25, FZ3 was not split into FZ3b and FZ3a and, as a result, the SFRA does not identify functional floodplain. Another issue associated with PPS25 is to incorporate new climate change figures. Whilst the Salford SFRA did address climate change, there may be areas where this needs to be updated to take into account PPS25. Finally, the Salford SFRA focused on particular development areas and floodplain, in particular, Lower Kersal, Charlestown and Lower Broughton. This detailed level of focus did not extend downstream of Lower Broughton and, depending on the planning aspirations of the District, it may be necessary to extend this detail further downstream. Should more detailed information be forthcoming on the Ship Canal, then this data must be incorporated into the updated SFRA.

Using the SFRA, Salford CC has recently (June 2007) drafted Planning Guidance relating to Flood Risk and Development in Salford. The draft Guidance makes the following recommendations[17]:

- Finished floor levels should be above the 100 year + 20% (included for climate change) event water level + an allowance for freeboard.
- New residential development within the floodplain should be designed so that finished floor levels for habitable rooms would be no more than 600mm below the predicted 1:1000 event water level.
- New development in Flood Zone 3 should not result in a net loss of flood storage capacity.
- New development in Flood Zone 3 should not have an unacceptable impact on the effectiveness of known linear flood flow routes. Where possible, new development should seek to enhance the effectiveness of flood flow routes and / or be designed to allow permeability to the through flow of water.
- New development in Flood Zone 2 and Flood Zone 3 should be of resilient construction up to the flood level predicted for the 1 in 1000 year flood event.
- New development proposed in Flood Zone 3 should provide safe access and egress routes that are signposted
- Planning applications for new development in Flood Zone 3 should be accompanied by an Emergency Planning Statement that details how the development will incorporate flood warning and evacuation procedures appropriate to the type and scale of the development and level of flood risk
- Existing ground floor uses in Flood Zone 2 and Flood Zone 3 should not be converted into habitable rooms where the flood level predicted for the 1 in 1000 year event would result in habitable rooms being flooded to a depth greater than 600 mm above floor level.
- New development in Flood Zone 2 and Flood Zone 3 and areas that suffer from sewer and surface water drainage flooding and new development of 1 ha or greater in Flood Zone 1 should demonstrate that the disposal of surface water from the site will not exacerbate existing flooding.

The Planning Guidance is proposed to be adopted by Salford CC in July 2008. It is anticipated that the final version will be amended to require site-specific FRA's for development sites adjacent to the Manchester Ship Canal until the information on flood risk associated with the Manchester Ship Canal becomes available (see Position Statement in Section 2.7.6).

[17] Salford City Council, 'Planning Guidance Draft Flood Risk and Development', June 2007

Flood Sources

PPS25 states that an SFRA should attempt to identify all sources of flooding. Five main flood sources have been identified in the Greater Manchester sub-region and these are summarised below. In addition, historical flood events have been presented to help identify areas of flood risk.

4.3 Flooding from Rivers (Fluvial Flooding)

The principal source of flood risk to the Greater Manchester Sub-Region is from fluvial flooding. A significant amount of information exists for the main watercourses and their tributaries across the four main catchments. Flood Zones were created for the SFRA using a variety of existing flood risk sources including outlines from existing hydraulic models and broad-scale modelled outlines. The Flood Zones were created in GIS and each flood outline contains meta-data describing where the data was received from, a confidence level for the data and a note on its suitability for use in the SFRA. Where possible, the most accurate and up-to-date information was used. Each outline used to create the SFRA flood zones assumes that no defences exist, except for Flood Zone 3b, functional floodplain.

However, there are areas where little or no accurate flood outlines exist, and therefore, to ensure a continuous coverage across the sub-region, broad-scale modelled outlines (the EA J-FLOW Flood Zones) were used as a proxy. This hybrid approach provides a conservative flood zone and highlights potential uncertainties that can either be resolved in more detailed district-level studies, or by developers as part of site-specific FRAs.

FZ2 – Flood Zone 2, Medium Probability of Flooding

No detailed modelled outlines exist for Flood Zone 2 in the Greater Manchester Area except for the River Irwell. Therefore, for the remainder of the sub-region, the EA broad-scale Flood Zone 2 maps were used.

FZ3a – Flood Zone 3, High Probability of Flooding

A hybrid FZ3a map was produced using a variety of different modelled outlines. Where modelled outlines did not exist, the EA broad-scale Flood Zone 3 maps were used instead.

FZ3b – Flood Zone 3b, Functional Floodplain

Where possible, 1:20 or 1:25 year detailed modelled outlines were used to define the functional floodplain. Generally, these outlines are defended (with an SOP great than 1:20/1:25) as only the undefended area can be classed as truly 'functional' floodplain. However, where purpose built flood storage basins or washlands exist, these are by their very nature functional and so have also been included. Following the precautionary approach advocated in PPS25 and, as agreed with AGMA and the EA, if detailed modelled outlines did not exist, then the SFRA FZ3a was used as a proxy to define the functional floodplain. This is a very conservative approach, but for the purposes of the sub-regional assessment, it allows identification of gaps and weaknesses in the data and helps define more detailed studies at the district-level. Where necessary, Flood Zone 3b has been trimmed and re-drawn, using professional judgement and in agreement with the EA, so that it conforms to the definition given in the PPS25 Practice Guide (sections 3.13 – 3.19). Namely, the effect of flood defences has been considered, solid buildings and existing infrastructure have been removed and water conveyance routes have been added.

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Derivation of Flood Zones

Whilst every attempt has been made to use the most up-to-date, accurate and detailed modelled data, there were some instances where it was necessary to use proxy data where modelled data was not available.

In the meantime, more detailed maps are being created showing all (currently available) sources of flood risk at a 1:10,000 scale across the whole sub-region. These also include a functional floodplain redefinition. With the EAs agreement and advice, Flood Zone 3b is being manually adjusted using modelled data, flood defence information, topographic data (LiDAR), aerial photography and professional judgement to produce a more realistic outline, following the PPS25 definition and avoiding the use of proxy data. This has already significantly reduced the area of FZ3b shown in across AGMA.

Limitations & Uncertainties – the River Medlock Example

Using proxy data to define flood zones presents a series of issues and limitations and uncertainties. This is especially true when Flood Zone 3a is used as a proxy for Flood Zone 3b. One such example is the River Medlock that flows through the centre of Manchester. This has not been modelled in detail and therefore, the only available information is the EAs broad scale modelling results.

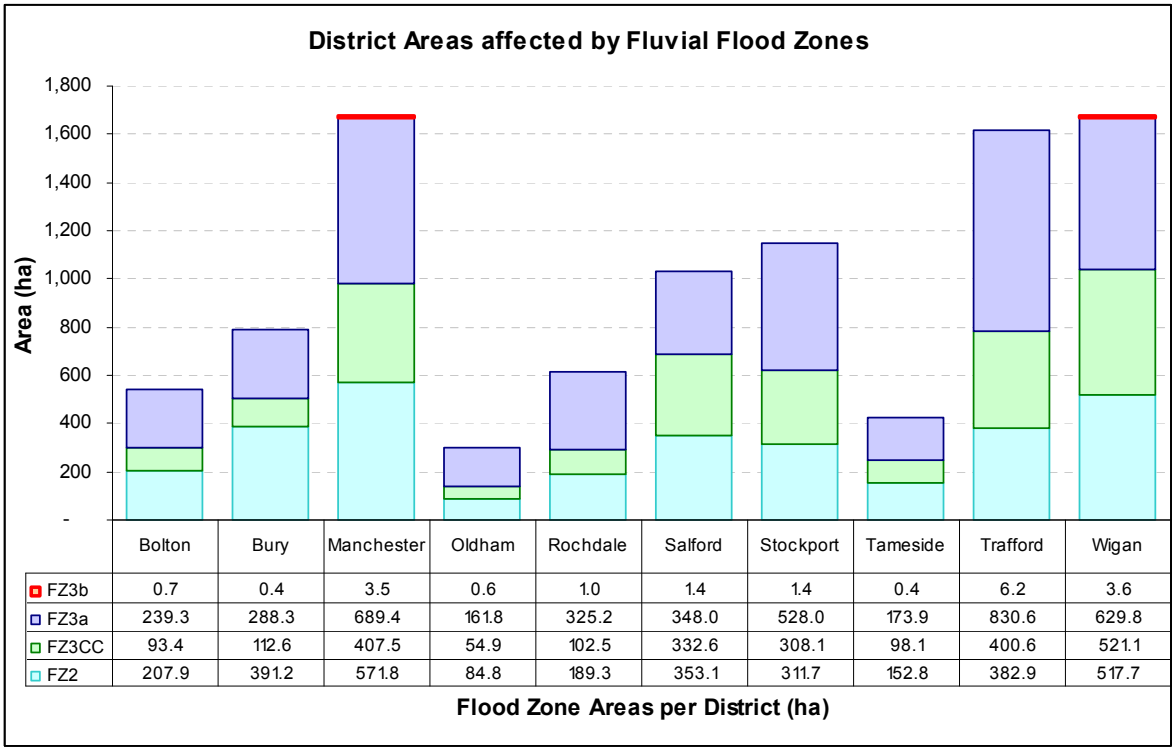
Due to the highly urban nature of the watercourse, it flows in a deep and often canalised channel and through large culverts or tunnels. However, broad-scale modelled outlines assume a “bank-full” state prior to flooding and therefore, large areas of the City Centre are shown to be flooded at both FZ3 and FZ2. Due to the lack of historical data, previously completed site specific FRAs and in consultation with the EA, the broad-scale modelled outlines for the Medlock and Corn Brook have been given a low confidence.

Confidence maps have been produced for each Flood Zone. The level of confidence assigned to each Flood Zone is a result of the level of assumptions and limitations when deriving that Flood Zone. See Figures A-6 – A-9 (Appendix A) for confidence maps of the sub-region.

AGMA and the EA have been working closely together on this matter and the EA have provided more, recently completed, flood outlines for the whole sub-region. In addition, the EA have recently commenced a Strategic Flood Risk Mapping project for the Medlock that will result in detailed modelled outlines for a range of return periods taking into account climate change. The outputs of this study are expected late 2008/early 2009. Until the new modelling study is complete, AGMA and the EA have agreed to take a pragmatic approach to continuing LDF progress.

Maps showing the level of confidence for each Flood Zone are presented in Figure A6 – A9 and Appendix B. Flood Zone confidence was determined based on the type of modelling technique that was used to derive the Flood Zone. Where detailed modelling techniques were used to derive a Flood Zone, a high confidence was assigned. Where broad-scale modelling techniques were used, a medium confidence was assigned because a greater number of assumptions are made in the modelling process. Where a proxy flood outline has been used (as described above) a low confidence was assigned to the Flood Zone. The maps are intended to be used as a tool to identify where future hydraulic modelling work is required.

The fluvial flood risk identified using these flood zones is presented in more detail in Appendix B. In addition, Figure A-5 in Appendix A summarises the flood risk to each District and for each Flood Zone. Figure 4-5 highlights the fluvial flood risk to each District and clearly shows that Manchester, Trafford, Salford, Stockport and Wigan have the largest areas of fluvial flood risk in the Greater Manchester Sub-Region.



	Bolton	Bury	Manchester	Oldham	Rochdale	Salford	Stockport	Tameside	Trafford	Wigan
FZ3b	0.7	0.4	3.5	0.6	1.0	1.4	1.4	0.4	6.2	3.6
FZ3a	239.3	288.3	689.4	161.8	325.2	348.0	528.0	173.9	830.6	629.8
FZ3CC	93.4	112.6	407.5	54.9	102.5	332.6	308.1	98.1	400.6	521.1
FZ2	207.9	391.2	571.8	84.8	189.3	353.1	311.7	152.8	382.9	517.7

Figure 4-5: Summary of Fluvial Flood Risk to Districts (May 2008, incorporating redefined FZ3b and latest EA modelling outputs).

4.3.1 Culverted Watercourses and Lost/Hidden Rivers

There are a significant number of culverted watercourses in Greater Manchester which is to be expected in a highly urbanised environment (Table 4-12). In addition to the identified culverted watercourses, there are also a number of "Hidden Rivers" or "Lost Rivers" within the sub-region, particularly Tameside, Manchester and Trafford Districts (Figure 4-6).

Table 4-12: Culverted watercourses by length per District in Greater Manchester, NFCDD, EA, 2007

Authority	Length of Culverted Channel (m)
Bolton	19,087
Bury	12,373
Manchester	19,643
Oldham	11,702
Rochdale	14,480
Salford	10,647
Stockport	7,341
Tameside	6,804
Trafford	13,092
Wigan	14,218
Grand Total	**129,387**

As the Manchester sub-region developed and grew, so watercourses were culverted, diverted, or even infilled to accommodate the amount of development associated with the industrial revolution. Some of these watercourses are known (for example, parts of the Medlock, Irk and Corn Brook). However, there are many that remain unknown or 'forgotten' and continue to flow through old culverts and tunnels beneath the City. The condition, standard of service and exact route of these culverts and tunnels is often unknown but they still present a potential flood risk to local areas in the City.

Culverts carry an inherent and often unknown risk of flooding as a result of debris blockage, siltation (and hence loss of capacity) and collapse. As a result, strategic and development control planners need to be aware of their locations when allocating development sites or specifying appropriate investigations for site specific FRAs.

Identifying the location of culverted watercourses using NFCDD (see Figure A-13 in Appendix A) and Manchester University data will allow planners to more carefully consider the location of sites for development and to consider potential mitigation options, which may include policies for site-specific FRAs and guidance as to what mitigation options may be required (for example, the potential to "daylight" culverts, or install improved trash screens on inlets to avoid blockage). Although many of these culverted watercourses are smaller than the major rivers in the region, they have the potential to pose a greater flood risk to people and property in terms as a result of more frequent flooding. The identification of culverted watercourses and hidden rivers will also be useful for developers and development control purposes.

Whilst fluvial flooding poses a significant risk to the sub-region, the impacts of other sources of flooding should not be underestimated or diminished. Smaller events from other sources that occur much more frequently can cause significant problems to properties and transport links and must therefore also be taken into account.

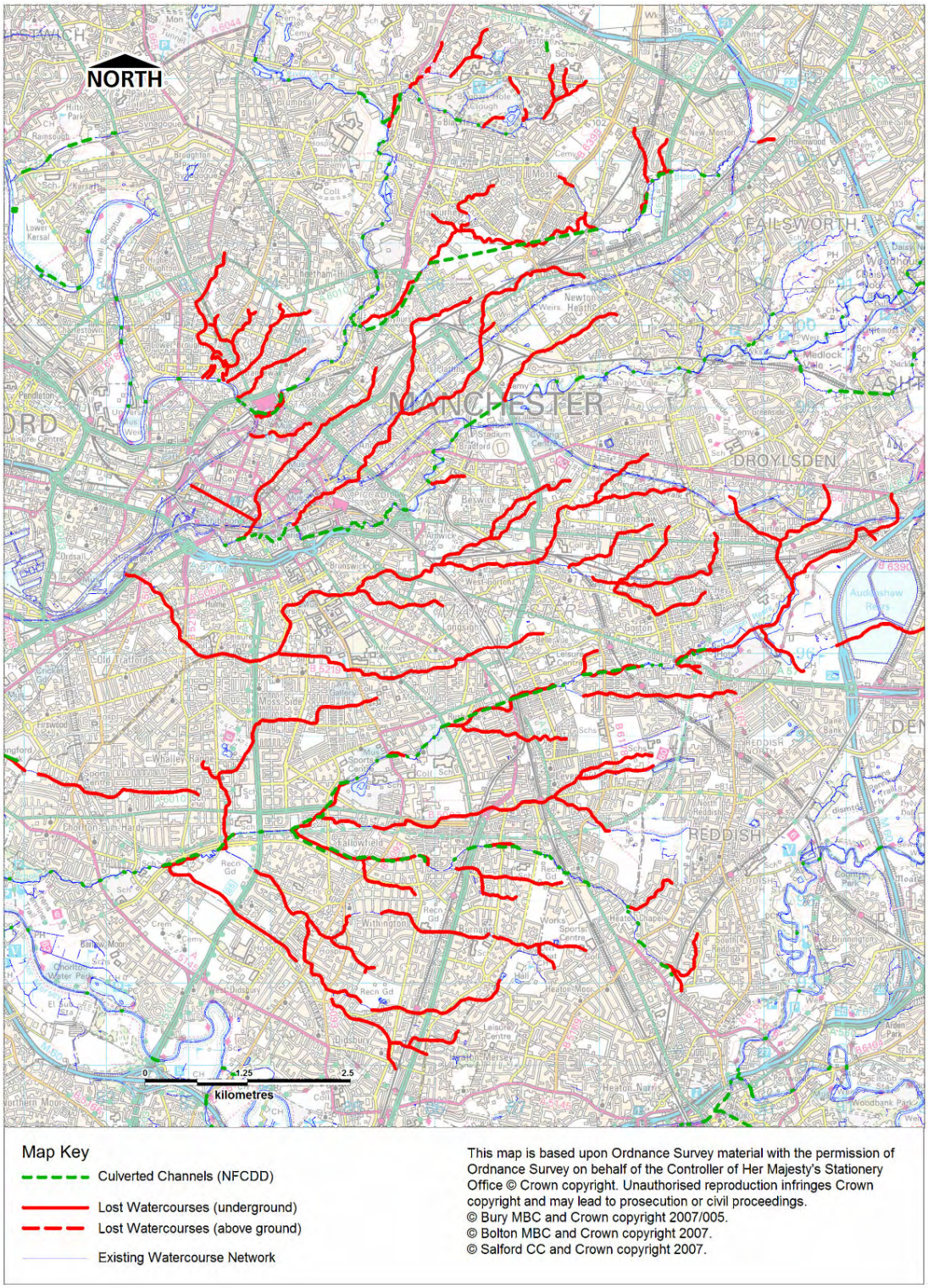


Figure 4-6: Identified "Hidden Rivers" in Manchester.
(Used and adapted with the kind permission of ERA-Net CRUE, Manchester University, 2007).

4.3.2 Flooding from the Land (Pluvial/Surface Water Flooding)

During periods of prolonged rainfall events and sudden intense downpours, overland flow from higher ground may 'pond' in low-lying areas of land without draining into watercourses, surface water drainage systems or the ground. Pluvial and surface water flooding is most likely to occur in areas of poor permeability and limited drainage and on steeper slopes; however, there is widespread potential for occurrences across the AGMA sub-region. In some areas, pluvial flooding may present a more significant risk than other sources of flooding, including fluvial.

One of the main issues with pluvial flooding is that in areas with no history, relatively small changes to hard surfacing and surface gradients can cause flooding (garden loss and reuse of brownfield sites for example). As a result, continuing development could mean that pluvial and surface water flooding can become more frequent and, although not on the same scale as fluvial flooding, it can still cause significant disruption.

Historically, Manchester, Bolton, Bury, Rochdale, Stockport, Tameside and Trafford have records showing that pluvial flooding has occurred. Some council representatives have stated that there is sometimes confusion between pluvial flooding and sewer flooding when members of the public report events. Therefore, some of the historical references could refer to either pluvial or sewer flooding or a combination of both.

Manchester University are currently undertaking research into flood risk management in small urban catchments. The study is part of the ERA-Net CRUE (European Research Network-Flooding), a European wide research programme and will be investigating the flood risk from culverted channels and hidden rivers as well as pluvial and surface water flooding in small urbanised catchments. It is recommended that the research team are contacted to determine how useful the study outputs may be to the Greater Manchester SFRA in determining areas of potential pluvial flood risk.

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Flooding from the Land - Limitations & Uncertainties

This type of flooding is frequently experienced and often very destructive and it is possibly a more serious problem than suggested by historic records. Surface water flooding does not need a watercourse in close proximity to occur and is exacerbated by areas of hardstanding such as tarmac.

This source of flooding tends to suffer from a lack of historic records and almost always no predictive data based on modelling. Given the prediction for increased frequency and intensity of rainfall with climate change, surface water and pluvial flooding are likely to become more frequent and serious.

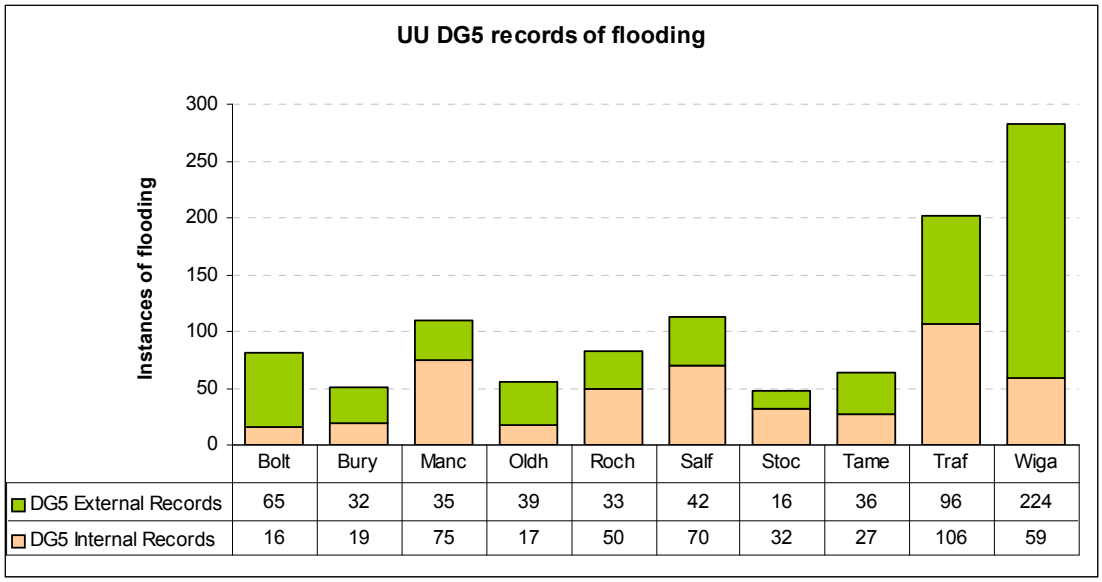
Current Position – Flooding from the Land

Given the lack of data and the uncertainty associated with current historical records, AGMA are examining the possibility of undertaking a high level surface water modelling exercise to identify contributing catchments, flood flow routes and flood accumulation areas across the whole of the sub-region. This will assist policy and development control activities.

4.3.3 Flooding from Sewers

Sewer and drainage flooding are another flood risk throughout the AGMA sub-region, particularly during severe rainfall events, where the design capacity of the sewer network is insufficient to cope with the high volumes of water. During periods of high river flow, there is the potential for such drainage systems to become 'tide locked' and unable to discharge to watercourses, or to surcharge due to a lack of capacity, resulting in the system backing up and flooding roads and properties. Alternatively, blockages to sewers and limited capacity can also cause water to back up and surcharge. As with pluvial flooding, sewer flooding has the potential to occur anywhere within the sub-region especially as a result of the high urban density. Sewer flooding was identified using historical records and data from United Utilities DG5 database (June 2007) detailing the total number of flood incidents that have affected both internal and external property (Figure 4-7).

Sewer flooding is known to have occurred in Salford where up to 1000 properties are at risk of sewer flooding and COWs flooding. The City of Salford SFRA identifies sewer flooding hotspots in Swinton, Walkden and Boothstown. Historic records show that urban areas including Salford, Eccles and Swinton are at particular risk of sewer and drainage flooding. Sewer flooding problems have also been identified in Trafford, Bury, Manchester and Wigan.



	Bolt	Bury	Manc	Oldh	Roch	Salf	Stoc	Tame	Traf	Wiga
DG5 External Records	65	32	35	39	33	42	16	36	96	224
DG5 Internal Records	16	19	75	17	50	70	32	27	106	59

Figure 4-7: Summary of UU DG5 Dataset showing instances of flooding across the AGMA Districts

It should be noted that much of the sewer network dates back to Victorian times, some of which is of unknown capacity and condition. More recent sewers are likely to have been designed to the guidelines in "Sewers for Adoption" (WRC, 2006). These sewers tend to have a design standard of up to the 1 in 30 year storm event (equating to approximately a 1 in 5 year flood flow), although in many cases, it is thought that this design standard is not achieved, especially in privately owned systems.

It is therefore likely that parts of the sewer system will surcharge during large, high intensity rainstorm events resulting in frequent flooding, particularly if the systems are combined and if climate change forecasts are correct. Due to the limited capacities and design standards, the level

of risk posed by and probability of sewer flooding is therefore greater than that of fluvial flooding, where the SFRA examines the 1 in 100 and 1 in 1000 year return periods.

United Utilities (UU) provide potable water distribution and wastewater collection for the whole of the Greater Manchester sub-region. United Utilities have provided a register of flood events that have affected properties (internal) and outside areas such as roads (external) to a five-digit postcode area (Figure A-10 in Appendix A). This information is provided to the regulatory body – OFWAT (Office of Water Services) and is used to help define their capital programme. The register is also known as the DG5 register, and contains commercially sensitive information that is also covered by the Data Protection Act (1998).

The data is purely a record of instances of flooding and does not provide an indication as to the current or future flood risk posed by the sewer network. For example, Wigan may have the highest number of recorded instances of sewer flooding, but the risks and consequences of sewer flooding may actually be higher in Bury or Oldham. As a result, a detailed analysis of the scale and consequences of sewer flooding has not been possible at this stage of the SFRA.

During the course of the sub-regional SFRA, discussions have been ongoing between UU, AGMA and the EA to determine how best to use and present results from more detailed UU sewer modelling data. UU have agreed to examine 45-50 planned development sites for each AGMA district and provide feedback on the risk of sewer flooding, water infrastructure and future capacity. However, it is unlikely that UU will release detailed sewer flooding information for direct use in the SFRA due to data protection/sensitivity issues.

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Flooding from Sewers - Limitations & Uncertainties

Due to the significance of sewer flooding in highly urbanised areas, the flood risk data that UU hold on their sewer network is classified as critical to contribute to addressing all sources of flood risk within the SFRA. Sewer and drainage flooding has been identified using DG5 records and historic recorded instances. It must be noted that DG5 data only covers a limited period of time and should be considered a snapshot of flooding. In addition, the DG5 dataset is only provided on a five-digit postcode area, which can be large and make it difficult to determine where a sewer flooding problems may have occurred in the past.

Current Position – Flooding from Sewers

More detailed sewer flooding models, such as those produced by UU for the Defra Integrated Urban Drainage Pilot Study (IUD) in Salford provide a much more detailed and useful appreciation of the risk posed. However despite this work, it looks unlikely that UU will agree to the release data it holds on flood risk from the public sewer network due to data protection/sensitivity concerns.

In the meantime, AGMA will continue to Liaise with UU in conjunction with the EA and GONW to explore how UU can participate and contribute to the SFRA.

4.3.4 Flooding from Manmade / Artificial Sources

British Waterways (BW) and Manchester Ship Canal Company (MSCC) operate and maintain most of the principal canals and navigable waterways within the Greater Manchester Sub-Region (Table 4-13) (Figure A-1, Appendix A).

Table 4-13: Principal Canals in the Greater Manchester Sub-Region

British Waterways	Manchester Ship Canal Company
The Leeds/Liverpool Canal	Manchester Ship Canal
The Rochdale Canal	Bridgewater Canal
The Manchester Bolton & Bury Canal	
The Huddersfield Narrow Canal	
The Ashton Canal	
The Peak Forest Canal	
The Leigh Branch	

There are few recorded instances of flooding from the canal networks as they tend to be heavily regulated and controlled. Nonetheless, flood risk from canals and navigable waters still exists where canals could overtop or breach. As the Ship Canal is privately run and operated, it falls outside of the remit of existing flood risk legislation and, consequently, the programme of flood risk modelling and mapping projects undertaken by the EA and local authorities. This has led to a 'gap' in the flood risk information available for the Greater Manchester Sub-Region. Similarly, the flood risk associated with canals operated and maintained by BW are also difficult to quantify as they also largely fall outside of the EAs strategic flood risk mapping projects (though in some cases, canal-river interactions are taken into account).

There are numerous reservoirs that are located either within or could have an impact on the Greater Manchester Sub-Region (Table 4-14). The EA have provided details of all Reservoir Act Water Bodies in region (Figure A-1, Appendix A). The main flood risks posed by reservoirs are as a result of emergency releases and breaching or overtopping of the holding structures (i.e. dam and embankments). The actual risks of overtopping or breaching of a reservoir body is a function of many factors including the condition of the actual control structures and the weather conditions of the time as well as human error. These are all difficult to quantify and few models exist demonstrating what the impacts of a reservoir failure would be. The locations and relative size of all the reservoirs have been included on Figure A-1 (Appendix A) that will help strategic planners to identify which potential development areas are downstream.

The EA have categorised each of these reservoirs with a risk rating, however, this data is classed sensitive information and therefore cannot be disclosed publicly. Where there is a known or perceived risk of flooding to a development site as a consequence of reservoir breach, failure or overtopping, then an appropriate analysis should be undertaken as part of a Site Specific FRA.

Table 4-14: Numbers of reservoirs in Districts

	Reservoirs	
	In District	**Immediately upstream of District**
Bolton	12	10
Bury	11	4
Manchester	5	5
Oldham	13	10
Rochdale	20	7
Salford	1	3
Stockport	0	5
Tameside	12	8
Trafford	2	3
Wigan	4	5

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Flood Risk from Canals - Limitations & Uncertainties

There are a number of canals located in the urbanised areas of the sub-region that are maintained and operated by British Waterways and Manchester Ship Canal Company. Flooding has been known to occur on some of these canals. At present, the current and future flood risk associated with canals is unknown.

Current position on Flooding from Canals

AGMA are to continue liaising and working with British Waterways to strive towards a mutually acceptable way of presenting potentially sensitive flood risk information associated with canals within the sub-region. In the meantime, councils considering development abutting BW canals may need to assess the condition, standard of service and flood risk through a more detailed study of the area prior to making strategic development decisions.

The Manchester Ship Canal (MSC) represents a critical risk issue for the Manchester City Region potentially affecting Salford, Trafford and Manchester. To allow councils to make informed decisions (with regard to flood risk) on regionally important development areas abutting the MSC, it is essential that the potential impacts of extreme flows and climate change are properly assessed.

In depth discussions have been held with MSCC to determine what, if any, flood risk information and knowledge is available for use. MSCC has recently commissioned a detailed modelling exercise of the canal[18] to determine how the canal will operate during a flood event and to enable the most efficient operational response. This exercise has now been completed. MSCC have provided the information to the EA to review and determine the flood risk issues, including a flood outline.

Once the EA and MSCC are satisfied with the outcomes, it is understood that the data will be made available to AGMA for use in the SFRA. Though exact timescales are not available at present, it is thought that the exercise will be complete in the Spring of 2009.

As the MSC is such a critical issue, contact will be maintained by AGMA and the EA to ensure all parties are aware of progress and any potential challenges. In the meantime, it will be necessary for AGMA and the councils directly affected by the MSC, to take a pragmatic approach to their LDFs, tackling risk and mitigation options as information comes to light.

[18] Modelling the Manchester Ship Canal, Water and Environment Journal, Vol. 21, No. 2.

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Flooding from Reservoirs - Limitations & Uncertainties

The main flood risks posed by reservoirs are as a result of emergency releases and breaching or overtopping of the holding structures (i.e. dam and embankments). The actual risks of overtopping or breaching of a reservoir body is a function of many factors including the condition of the actual control structures and the weather conditions of the time as well as human error.

Current position of Flooding from Reservoirs

At present flood risk from reservoirs is unquantified in the sub-region. The Water Act 2003 amended the Reservoirs Act 1975 and introduced a requirement for reservoir undertakers to prepare reservoir flood plans. It is important that arrangements are in place so that emergency services can respond effectively in an emergency, which, at worst, could lead to flooding following an uncontrolled release of water from a reservoir.

Defra and the EA are currently funding a project to produce a 'Guide to Emergency Planning for UK Reservoirs'. The final Guide will go out to formal consultation in Summer 2008, and will be subject to a Regulatory Impact Assessment.

A reservoir flood plan will include:

- an inundation analysis to identify the extent and severity of flooding which could result from an uncontrolled release of water;
- an on-site plan setting out what the undertaker would do in an emergency to try to contain and limit the effects of the incident;
- a communications plan with external organisations, mainly the emergency services.

Reservoir flood plans are expected to become a legal requirement in Spring 2009 when the Secretary of State in England and the National Assembly in Wales will direct undertakers to produce flood plans for reservoirs where failure could have a major impact.

When reservoir flood plans become available, the SFRA will be updated and they will be used to help inform future development allocation, mitigation options and development control activities. In the interim period, districts with significant and important proposals for development immediately downstream of a Reservoirs Act water body may need to consider undertaking inundation maps prior to the production of a reservoir flood plan.

4.3.5 Flooding from Groundwater

Groundwater flooding tends to occur sporadically in both location and time. When groundwater flooding does occur, it tends to last longer than fluvial, pluvial or sewer flooding and mostly affects below surface infrastructure and buildings (for example, tunnels, basements and car parks). There are several principal causes of groundwater flooding and include:

- Natural groundwater rises due to exceptionally wet periods (usually over the season timescale, for example, a whole summer) where groundwater is recharged rapidly. This can reactivate springs and "dry valleys".
- Groundwater rebound due to cessation of abstraction and mine dewatering
- Shallow drainage and flooding problems due to local conditions.

Searches revealed relatively few reported incidents of groundwater flooding in the sub-region. Parts of the Upper Douglas catchment immediately adjacent to Wigan District are known to have suffered from groundwater flooding in the past. However, work undertaken by DEFRA and the EA[19] has shown that flooding from groundwater may become more of an issue due to the cessation of dewatering mines. During coal mining operations, the area was extensively dewatered, however, since coal mining in the area ceased, groundwater levels have risen.

The bedrock geology of the sub-region can be very broadly defined as consisting of a Permo-Triassic sandstone "arc" encompassing large portions of Salford, Trafford, Manchester, Stockport and Wigan (Figure A-4, Appendix A). This is defined as the Sherwood Sandstone Group and is classed as a Major Aquifer under the EA's Groundwater Vulnerability maps (Figure A-3a, Appendix A). Overlaying the aquifer in Bury, Salford, Manchester, Trafford and Stockport are superficial deposits (Figure A-2, Appendix A) consisting predominantly of sands and gravels, meaning that permeability is relatively high. It is in this region that the EA have identified groundwater recharge as a result of the cessation of mine dewatering. The remainder of the sub-region consists of mixed mudstones, siltstones and sandstones that are classed as minor aquifers and overlain with glacial tills with lower permeability.

According to the EAs water resources team and groundwater assessments, the risk posed by groundwater flooding is likely to remain remote within the sub-region, however, the impacts of increased development in Greater Manchester must be carefully assessed. For example, infiltration based SuDS methods may increase groundwater levels locally. Similarly, increases in grassed and open areas can also contribute to increased groundwater recharge in addition to a reduction in abstraction rates as a result of the heavy industry and manufacturing decline.

4.3.6 Historical Flood Events

A review of information supplied by the councils, the EA, CFMPs, and through searching online historical records[20,] has revealed that numerous flood events have occurred in the sub-region over the last 150 years. A total of 89 recorded flood events were identified from these sources though it is probable that more unrecorded events have occurred. Historical flooding records for each council are presented in Appendix B of this report.

The records show that the sub-region is vulnerable to both periods of prolonged rainfall in the autumn and winter months leading mainly to large, fluvial events, and local flash flooding caused

[19] Groundwater Flood Risk and Management in the North West Region, Environment Agency, 2007.
[20]British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe

primarily by smaller watercourses, surface water and sewers. Most recorded events identified are as a result of fluvial flooding though there are also numerous records of surface water and sewer flooding. It is interesting to note that of all of the identified events, most occurred during July and August (Figure 4-8) with a large proportion of these floods being pluvial, sewer or combined (i.e. records show that fluvial flooding occurred as well as sewer and surface water flooding).

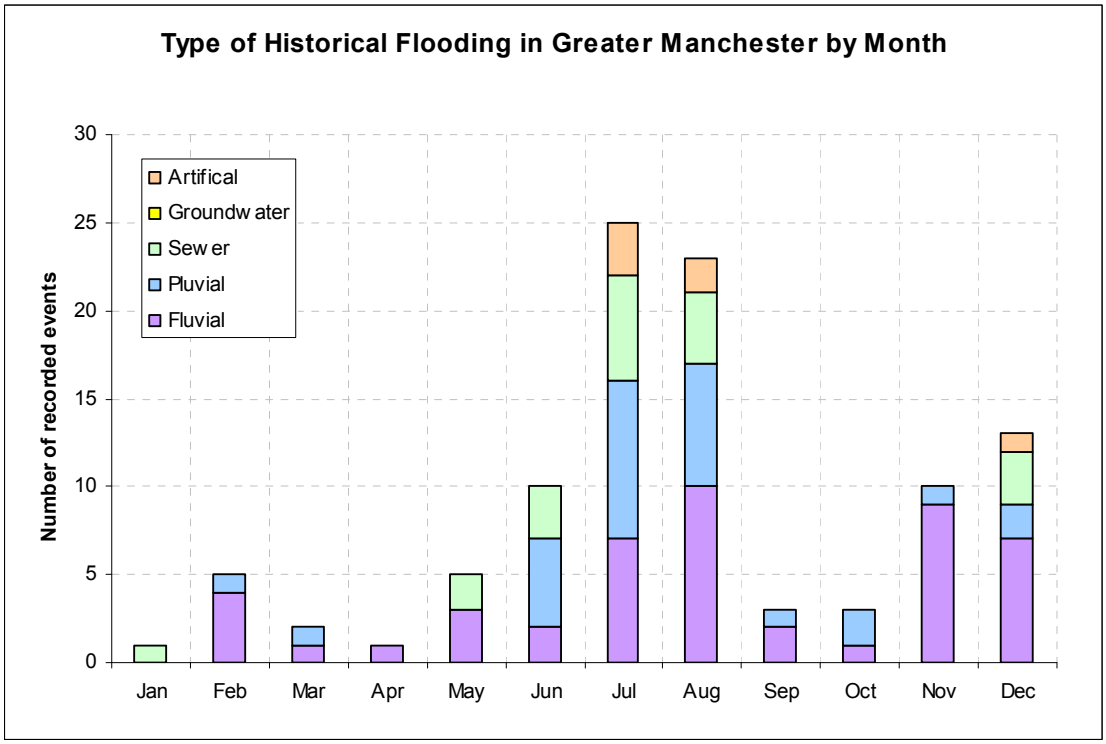


Figure 4-8: Flood seasonality and type as determined from identified historical flood events.

This pattern of flooding tends to concur with high intensity summer rainstorms and reflects the general pattern experienced across the UK. As warmer air masses move over the sea towards the UK, they absorb more water, which leads to a greater intensity of rainfall on land. In highly urbanised areas such as Greater Manchester, this type of flood event can lead to rapid runoff and can overwhelm local drainage systems and critical ordinary watercourses.

Figure 4-9 shows the distribution of recorded flood events across Greater Manchester by council and type. It is important to note that the historical flooding data presented in Figure 4-9 does not include United Utilities sewer flooding data and is derived from publically available data sources such as CFMPs, Local Authorities and internet searches. DG5 data provided by UU is considered to be a separate dataset and is presented in Figure 4-7. It is important to note that flood events may have occurred that have not been recorded (for example, pluvial flooding may have occurred in Wigan but no records are present).

Clearly, Salford is shown to have significant historical flooding, in particular fluvial and sewer flooding. Many of the recorded incidents are as a result of flooding from the River Irwell. Wigan has a similar number of recorded fluvial flood events as do Manchester and Trafford. As discussed in Section 3.1.4, these four councils also have the highest RSS housing targets and therefore potential conflicts between development pressures and flood risk start to emerge.

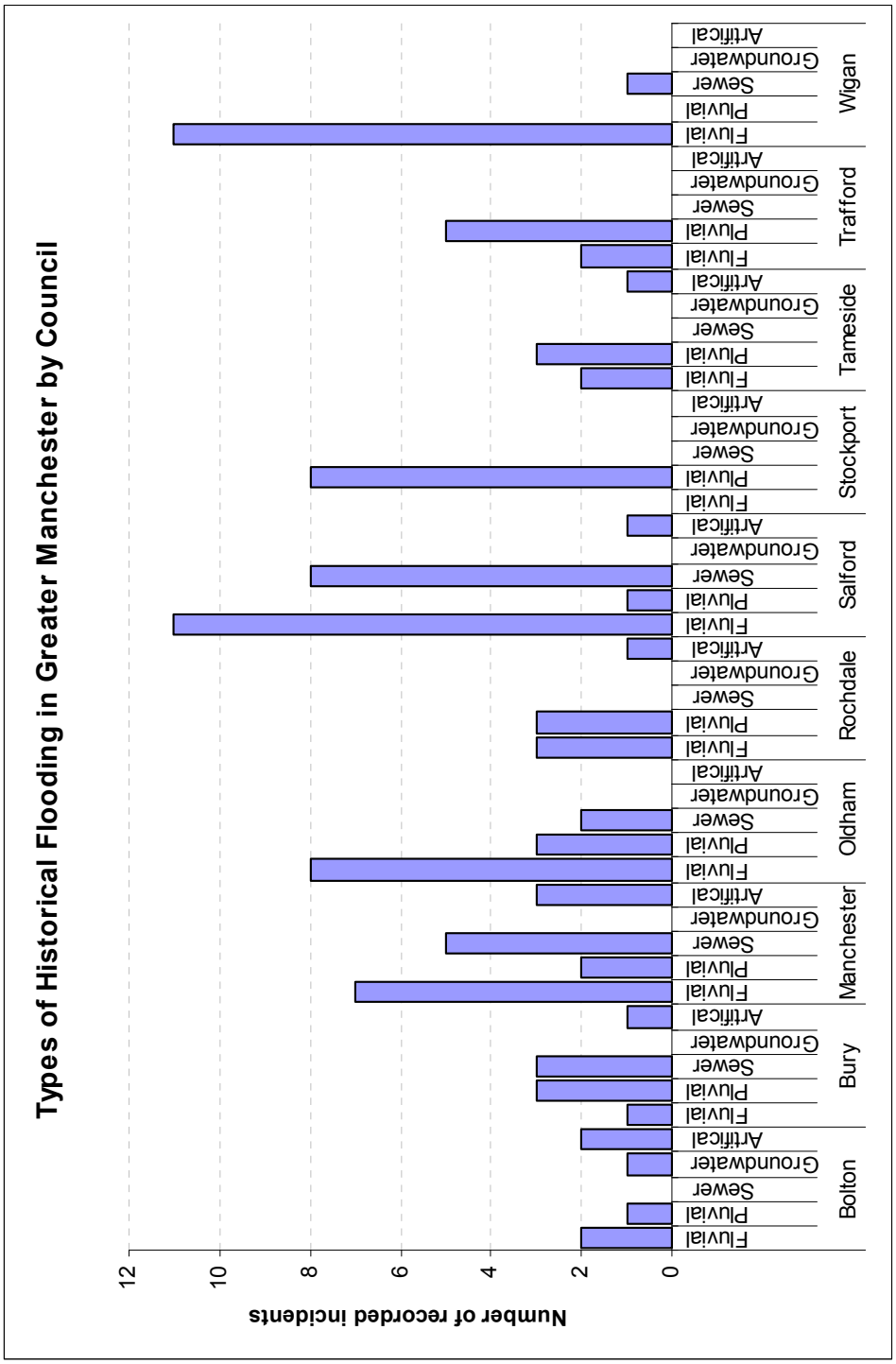


Figure 4-9: Flood type as determined from identified historical flood events.

4.4 Climate Change and Future Flood Risk

PPS25 updates the approach to estimating the impacts of climate change on flooding by using newer scenarios forecast by the UKCIP (UK Climate Impacts Programme – Scenarios 2002). In addition to increasing the peak flow of larger watercourses (by up to 20%), PPS25 now also includes an increase in the peak rainfall intensity of up to 30%. This will seriously affect smaller urban catchments, leading to rapid runoff to watercourses and surface water flooding, surcharging of gullies and drains and sewer flooding.

The CFMPs have also considered flood risk for the next 50-100 years and have taken into account the flood risk drivers of climate change, urban development and changes in land use. Catchment models and the Modelling and Decision Support Framework (MDSF) software were used in the CFMP to test sensitivity to the flood risk drivers across the catchments in the sub-region. Defra/UKCIP guidance on climate change has been used in the sensitivity analysis. This includes an increase of up to 20% of peak flows and runoff in rivers. However, a 30% increase in rainfall affecting smaller catchments has not been undertaken at this stage.

To account for climate change at the sub-regional level, fluvial FZ3 modelled outlines (including the effects of climate change) were obtained. Where there are no modelled climate change results, an estimate of the impacts of climate change on flood outlines is required. To this end, the FZ2 outlines were used as a proxy. This is not to say that the 100 year flood outline will necessarily increase to the 1000 year outline, but rather that one would expect the depth and extents of flooding to increase to somewhere between the 100 year and 1000 year outlines. This is a conservative approach designed to help strategic planners identify where increased detail and resolution in the flood outlines is needed at either more detailed District Level SFRAs or Site Specific FRAs.

Sewer and surface water flooding are likely to become more frequent and widespread under urbanisation and climate change scenarios as the amount of impermeable surfaces and runoff increase. The ASCCUE (Adaptation Strategies for Climate Change in the Urban Environment)[21] programme examined surface water runoff during extreme rainfall events in the Manchester sub-region. Through the use of Urban Morphology Types (UMTs – a map of Greater Manchester broken down into small regions based on aerial photography), the research identified that with an increase in development in Greater Manchester, there comes an increase in the amount of impermeable areas. Potentially, this could lead to an increase in runoff during storm events. The ASCCUE project made use of the UKCIP 2002 (Hulme, M. et al 2002) climate scenarios (as did PPS25) and, in one of the worst-case modelled scenarios, an increase in rainfall of 56% by 2080, led to an increase in runoff of 82% within the Greater Manchester sub-region.

The location of future urban developments and flood defences within a catchment can heavily influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments. Impacts include the lowering of the standard of protection offered by flood defences and the carrying capacity of culverts, drains, sewers and watercourse channels. This potentially leads to areas being at risk of flooding that were previously not at risk and highlights the increasing conflicts and pressures that are emerging between climate change scenarios and future development aspirations.

[21] Handley, J and Carter, J (2006) Adaptation Strategies for Climate Change in the Urban Environment. Draft final report to the National Steering Group. University of Manchester. ESPRC Report GR/S19233/01

The PPS 1 Supplement sets out important objectives in order to tackle climate change, sea level rise and avoid flood risk. The purpose of design policies should be to ensure that developments are sustainable, durable and adaptable to natural hazards such as flooding. Following this guidance, it should be possible to mitigate against increased flood risk through incorporating 'flood proofing' measures such as raised finished floor levels into the development design, and/or development of compensatory storage and flood storage basins.

4.5 Flood Risk Mitigation and Management

4.5.1 Flood Risk Management

Due to the history of flooding, the urban extent and the industrial heritage of the sub-region, there are numerous structures and embankments (either purpose built or natural) that contribute to flood risk management. The EA have discretionary powers to provide a flood risk management service that includes building and maintaining physical structures and raised defences and providing flood warnings.

The EA maintains records of all flood risk management assets in the sub-region using the National Flood and Coastal Defence Database (NFCDD). This database has been made available for use within the SFRA and will prove a valuable tool for planners to identify where potential development sites may fall under defended areas and to what standard of protection and condition the defences and structures provide. Appropriate levels of assessment can then be specified to allow the application of the exception test if necessary. There are a number of assumptions and limitations associated with NFCDD that should be taken into account when scrutinizing the data. These include:

- A default value of 1:50 year SoP is assumed where little or no information is available to make a detailed assessment.
- Whilst comprehensive in its coverage, NFCDD is a "living database" and is constantly being updated with new or revised information as part of ongoing maintenance programmes. As a result, there may be assets that have not been included yet.
- Conditions of assets are, where possible, based on detailed condition assessments. However, where information is not available, conditions are based on a visual survey.

The EA maintain and monitor a substantial range of FRM assets within the sub-region ranging from defences and structures on smaller, critical ordinary watercourses to major flood alleviation schemes such as the storage basins at Didsbury and Sale on the River Mersey. However, it should be noted that there are a great deal more "private" and "non-maintained" assets that may provide a level of protection, or indeed, increased risk to certain areas.

The SoP and condition of these assets is largely unknown and therefore the risks and consequences associated with failure are difficult to quantify (Figure 4-10) and councils should consider implementing policy and guidance to allow these assets to be investigated in more detail at site specific SFRAs.

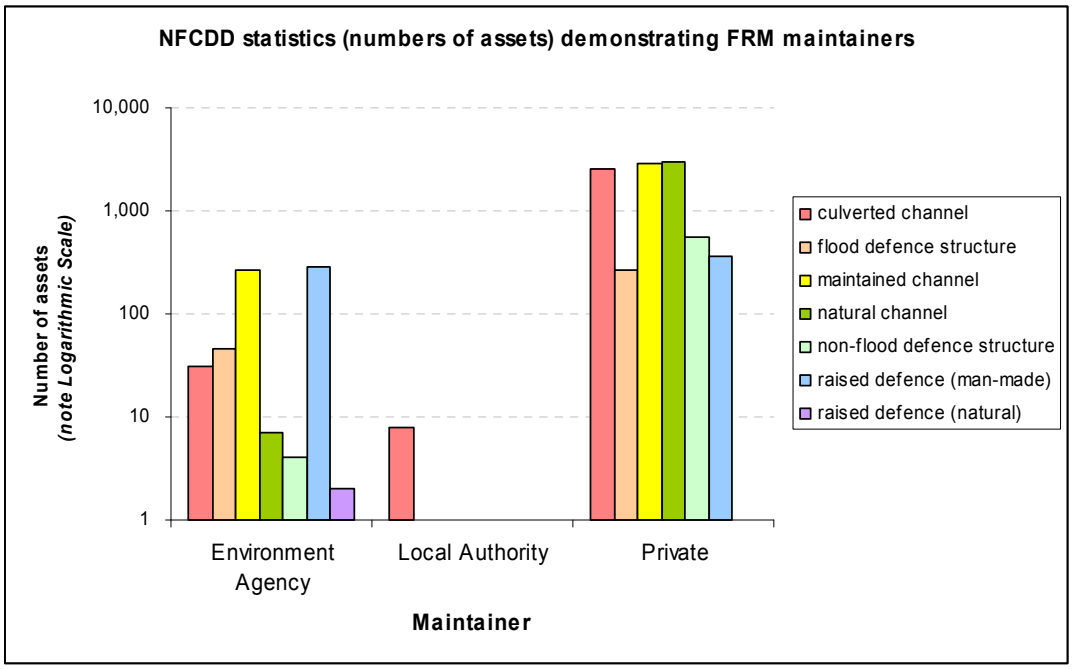


Figure 4-10: Summary of the number of assets maintained by the EA, Councils and Private landowners

The standard of protection for defences within the sub-region varies markedly, however the greatest proportion provides a level of service of between 25 and 50 years. Rochdale, Stockport, Bury and Bolton have more linear defences recorded in NFCDD and the greatest proportion of defence providing a standard of protection of between 50 and 100 years (Table 4-14).

However, Bolton, Bury and Rochdale are also located in the mid to upper catchment of the Irwell and therefore providing defences to a high standard could have a big potential impact downstream by channelling and conveying more flood flows to the Districts in the lower catchment. This highlights a potential conflict between development aspirations in Bury, Bolton and Rochdale and the impacts this will have downstream on other Districts, in particular, Salford, Manchester and Trafford.

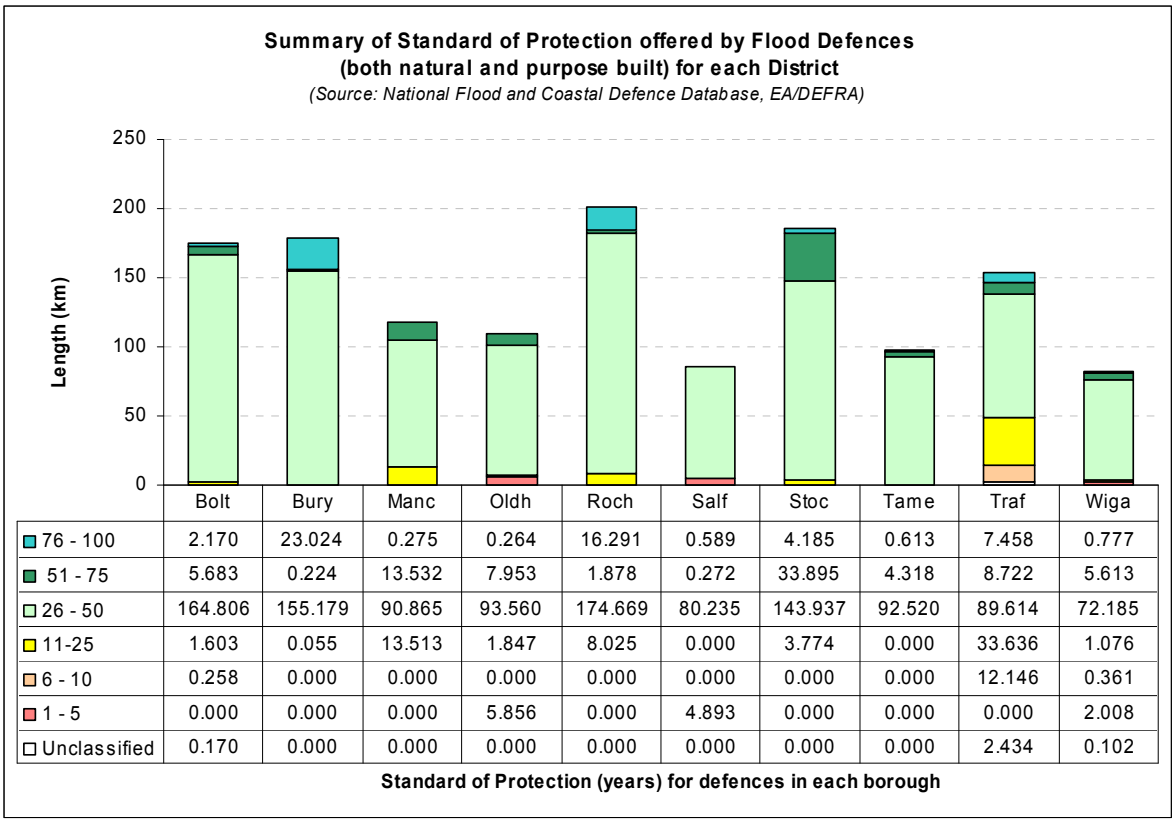
At present, there are five formally maintained flood storage areas (FSA) in the sub-region and include:

- Didsbury FSA - Mersey
- Sale FSA – Mersey
- Lilford FSA – Glaze
- Lower Kersal (Littleton Road) FSA – Irwell
- Timperley FSA – Timperley Brook

These are all located in middle to lower catchments. As the CFMPs have all stated, locating and providing strategic flood storage in upper catchment areas can potentially provide protection to areas much further downstream. However, the Irwell CFMP has also suggested that whilst flood storage in the upper areas of the catchment may have the potential to reduce levels downstream

(0.2m in Salford for example), ultimately this would have limited benefits in terms of reducing flows and damages.

Figure A-11 (Appendix A) shows the locations and design standards (assumed in many cases) of linear defences in the Greater Manchester Sub-Region.



	Bolt	Bury	Manc	Oldh	Roch	Salf	Stoc	Tame	Traf	Wiga
76 - 100	2.170	23.024	0.275	0.264	16.291	0.589	4.185	0.613	7.458	0.777
51 - 75	5.683	0.224	13.532	7.953	1.878	0.272	33.895	4.318	8.722	5.613
26 - 50	164.806	155.179	90.865	93.560	174.669	80.235	143.937	92.520	89.614	72.185
11-25	1.603	0.055	13.513	1.847	8.025	0.000	3.774	0.000	33.636	1.076
6 - 10	0.258	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.146	0.361
1 - 5	0.000	0.000	0.000	5.856	0.000	4.893	0.000	0.000	0.000	2.008
Unclassified	0.170	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.434	0.102

Figure 4-11: Summary of SOP provided by flood defences in the AGMA sub-region.

5 Sub-Regional Strategic Overview

The purpose of the Sub-Regional Strategic Overview is to bring together the planning policy and flood risk reviews into a combined assessment. This allows potential conflicts, themes, trends and patterns to be identified between the future development aspirations of each District and flood risk issues.

5.1 Consequences of Upstream and Downstream Development

The main potential adverse impacts that future development may have on downstream areas is twofold:

Reduction in Floodplain: Unrestricted development in floodplains can reduce the natural flood storage capacity of a river and, consequently, convey more water downstream – especially if newly developed areas are defended to a high SoP.

Increase in Runoff: Without careful planning policies, the increase in impermeable areas as a result of new development can increase the net volume of runoff entering watercourses. This can increase flood risk downstream and reduce water quality. These effects will be increased as a result of climate change, making matters worse.

To assess the effects and consequences of development on downstream areas, hydrological link schematics were produced. These demonstrate how the different councils in the sub-region are connected and what the cumulative effects of development between them are downstream. The schematics are based on hydrological connectivity and therefore Districts outside of the AGMA sub-region may also contribute to and/or be affected by development in other Districts. For example, the River Irwell flows from Rossendale DC and into Bury MBC and similarly, the River Beal flows from Oldham into Rochdale.

As well as showing the hydrological links between Districts, the schematics also contain the revised RSS housing target figures for each District. These are schematised figures designed to highlight connectivity and impacts and are therefore not to scale or geo-referenced. An assessment of the impacts of development upstream and downstream using these schematics is presented for each District in Appendix B.

An example is shown in Figure 5-1 for Salford City Council. Broad development upstream of Salford on the River Irwell and the within the Glaze Brook catchment is defined within the RSS in terms of housing figures. The Districts upstream that are hydrologically connected to Salford therefore have the potential to adversely affect the current flood risk in Salford. As the District is located towards the downstream extent of the Irwell and Upper Mersey (via the Manchester Ship Canal) catchments, there is potential for development from 12 Districts, both within and adjacent to, the AGMA sub-region to affect flood risk in Salford.

Should RSS housing targets be met, for example, a total of 145,100 new homes will be built in Districts upstream of Salford. A further 97,840 homes are proposed in Districts downstream of Salford. These figures are for net new housing and so are additional to the current levels of development.

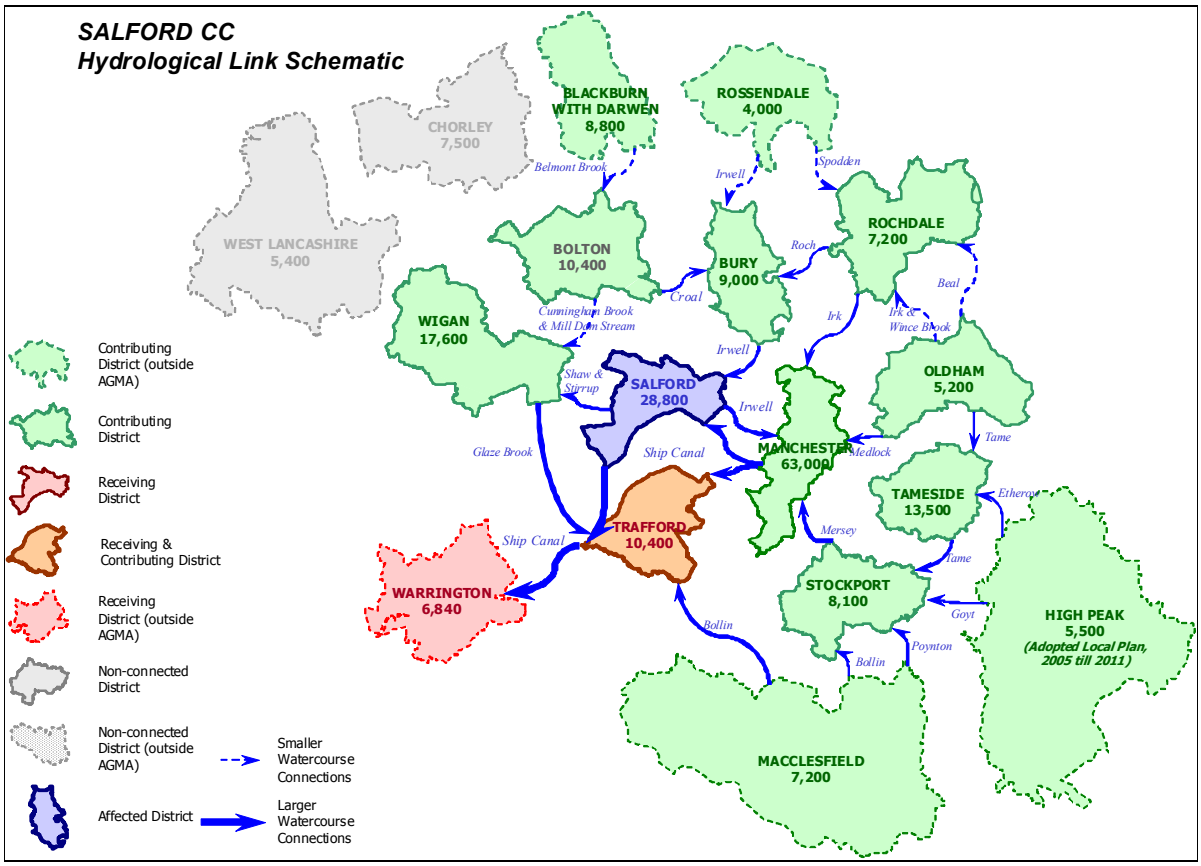


Figure 5-1: Hydrological Link Schematic for Salford City Council.

At a sub-regional scale, the consequences of development in one District on another become a serious issue when cumulative effect of proposed net new housing is taken into account. Table 5-1 summarises the cumulative housing target totals upstream and downstream of each District in or affected by the AGMA sub-region. From the table, it can be seen that, within AGMA, Manchester, Trafford and Salford are potentially worst affected by housing development upstream. This is due to the fact that all three lie at the downstream extent of the catchments affecting the sub-region and, consequently receive flow from all Districts upstream. The three Districts also form part of the Inner Area surrounding the Regional Centre and, as a result provide the focus for sub-regional growth and redevelopment (see Sections 3.1.3 and 3.1.4). For this reason they also have the highest combined RSS housing target of 102,200 new homes by 2021 – 59% of the total AGMA allocation. The Districts also have the highest existing population densities (see Section 5.4) and properties at risk of flooding.

If no measures are taken to control runoff or development in floodplains upstream, there is a serious potential for some of the new development to cause an increase in flood risk to Manchester, Salford and Trafford that could leave future development within the Manchester City Region highly exposed and vulnerable to flooding. This risk is further increased when climate change is taken into account.

Table 5-1: Total cumulative housing targets upstream and downstream for each District (excluding possible Growth Point Targets)

Local Authority	Net RSS Targets	Cumulative Development targets Downstream	Cumulative Development targets Upstream
Blackburn with Darwen	8,800	128,440	-
Bolton	10,400	148,540	8,800
Bury	9,000	109,040	35,600
Chorley	7,500	23,000	10,400
High Peak	5,500	130,640	-
Macclesfield	7,200	88,340	-
Manchester	63,000	46,040	107,700
Oldham	5,200	146,840	-
Rochdale	7,200	118,040	9,200
Rossendale	4,000	125,240	-
Salford	28,800	97,840	145,100
Stockport	8,100	109,040	31,400
Trafford	10,400	35,640	188,300
Tameside	13,500	117,140	10,700
Wigan	17,600	22,640	46,700
Warrington	6,840	-	198,700
West lancs	5,400	-	35,500

In reality, however, it is likely that new development will be constructed to modern and sustainable standards incorporating, where possible, SuDS to limit runoff and locating development within lower flood risk areas. Nonetheless, it is important that consistent development policies are adopted across the sub-region (including agreements with neighbouring councils if possible) that require the careful use of SuDS, consideration of the downstream implications that development areas may have and appropriate mitigation measures to minimise any increased downstream flood risk.

The councils upstream of Manchester, Salford and Trafford that are likely to have a significant effect on minimising the potential increase in flood risk can be split into two main groups based on catchments:

- Bolton, Bury, Oldham and Rochdale – Irwell Catchment
- Stockport and Tameside – Mersey Catchment

In addition to consistent policies across the sub-region, these groups could explore more specific flood risk policies amongst themselves that would make use of the CFMPs and help to minimise the impacts of their development on the Regional Centre and Inner Areas.

5.2 Potential Conflicts between Development Aspirations and the PPS25 Sequential Test

The flood zone maps and records of other types of flooding within the sub-region were used in conjunction with the broad-scale RSS development map (see Section 3.1.4) to determine areas within the sub-region and within each District where a potential conflict may exist between future development and the PPS25 Sequential Test. This has been summarised in Table 5-2 and Table 5-3.

The main potential conflict areas are within the Region Centre where, as discussed above, the largest quantum of development is proposed. However, these areas are also some of the most densely populated and intersect with major flood risk areas, including the River Irwell, the Manchester Ship Canal and the urban and hidden rivers within Manchester. It is likely that development in these areas will come into conflict with the Sequential Test and require the Exception Test to be undertaken. This will be examined in more detail during a Level 2 SFRA.

To the north of the Regional Centre the main areas of potential conflict are in the town centres and their surrounds where development areas intersect with fluvial flood zones or with areas known to suffer from sewer and pluvial flooding. For example, proposed development within Bury is located predominantly in Bury and Radcliffe Town Centres and their surrounds. The River Irwell flows through both towns. Similarly, development within Rochdale includes the Heywood Area and Rochdale Town Centre, where repeated instances of sewer flooding have occurred in the past. Potential flooding from the River Douglas and Glaze Brook intersect with the development areas of Wigan.

To the South of the Region Centre, the areas of potential conflict tend to also concentrate around town centres and their surrounds. For example, Altrincham is affected by flooding from Timperley Brook, whilst development areas to the north of the Town Centre, including Broadheath, are at risk from Sinderland Brook and potentially the Bridgewater Canal. Conflicts could also exist in Ashton-under-Lyne and Mossley in Tameside as a result of flooding from the River Tame. Other development areas in Tameside are expected to be more dispersed and therefore pluvial and sewer flooding could cause conflict with the Sequential Test.

These areas of potential conflict need to be examined in more detailed studies so that sufficient information is available to planners to allocate land and to undertake the Sequential Test.

More detailed studies, including detailed maps (1:10,000 scale), a SuDS map, Flood Zone confidence maps and a Framework for undertaking Level 2 SFRAs are currently being completed to help Districts identify, more clearly, where conflicts exist. Together with this sub-regional report, these additional studies fulfil the requirements of a Level 1 SFRA as defined in PPS25. Individual Districts should use this report including the supporting technical information in Appendix B and the outputs from the additional studies to assess development aspirations and sites and to undertake sequential testing and identification of Level 2 assessments.

Appendix B contains maps and summaries of all the Districts that combine flood risk information and development areas.

Table 5-2: Summary of flood risk and planning issues fro Greater Manchester

	Flood Sources					Planning Issues	
	Surface Water/Pluvial	**Sewer**	**Groundwater**	**Fluvial**	**Artificial**	**Potential development**	**Areas of potential conflict with PPS25**
Bolton	✓ Horwich Area	✓ Horwich & Bolton	Not known (see Table 2-2)	✓ Croal at Bolton	✓ Canal Breaches at Nob End have occurred	Bolton, Horwich and Westhoughton Town Centres and Surrounds	Horwich and Bolton with sewer flooding, Croal affects Bolton Development Areas, Moses Gate.
Bury	✓ Bury, Ramsbottom, Summerseat, Whitefield	✓ Radcliffe and Ramsbottom	Not known (see Table 2-2)	✓ Irwell at Ramsbottom, Bury and Radcliffe	Not known (see Table 2-2)	Bury, Radcliffe, Prestwich, Ramsbottom. Town Centres and Surrounds.	Bury, Radcliffe and Ramsbottom are all affected by The Floodplain of the River Irwell.
Manchester	✓ Ardwick, Fallowfield, Withington, Moss Side, Manchester University	✓ Fallowfield, Moss Side	✓ Groundwater levels rising following cessation of mine dewatering	✓ Mersey at Didsbury, Northenden. Chorlton Brook, Medlock, Irk	✓ Ship Canal. Bridgewater Canal Overtopping	Manchester Inner Area, Regional Centre and City Centre. Wythenshawe and Airport.	Manchester City Centre and Inner Area and unquantified risk from Manchester Ship Canal, River Irk and Medlock. Chorlton Brook floodplain and Inner Area - Chorlton-cum-Hardy, Fallowfield and Withington
Oldham	Not known (see Table 2-2)	✓ Royton, Shaw, Chadderton, Oldham	Not known (see Table 2-2)	✓ Medlock at Oldham, Irk at Royton, Wood Brook, Grotton Hollow, Beal	Not known (see Table 2-2)	Large HMR area where sites will be placed. Oldham, Chadderton and Royton Centres and Surrounds	Central Oldham, Chadderton, Royton and Shaw, pluvial and sewer flooding problems.
Rochdale	Not known (see Table 2-2)	✓ Heywood, Rochdale, Wardle	Not known (see Table 2-2)	✓ Roch at Rochdale, Irk at Middleton	✓ Rochdale Canal Overtopping, Middleton	Heywood, Kirkholt, Middleton, Rochdale. HMR area. Town Centres and Surrounds	Conflicts in Heywood due to sewer and pluvial flooding.
Salford	✓ Boothstown, Walkden North & South & Ellenbrook	✓ Barton, Boothstown, Walkden North & South & Ellenbrook, Broughton, Claremont, Eccles, Ellesmere Park, Kersal, Little Hulton, Swinton North & South, Weaste & Seedley, Winton, Worsley	✓ Groundwater levels rising following cessation of mine dewatering	✓ Irwell at Lower Broughton, Kersal and Charlestown.	✓ Ship Canal Overtopping at Barton	Central Salford Inner Area, Salford Quays (Regional Centre), Western Gateway including Cadishead and Barton. Town Centres.	Regional Centre (Salford Quays), Western gateway (Barton, Cadishead) due to potential flood risk from Ship Canal. Barton due to Worsley Brook and Lower Broughton, Kersal and Charlestown due to Irwell flooding.

Table 5-3: Summary of flood risk and planning issues fro Greater Manchester

	Flood Sources					Planning Issues	
	Surface Water/Pluvial	**Sewer**	**Groundwater**	**Fluvial**	**Artificial**	**Main aspirational development**	**Areas of potential conflict with PPS25**
Stockport	Not known (see Table 2-2)	✓ Brinnington, Cheadle, Gatley, Marple Bridge, Bredbury	✓ Groundwater levels rising following cessation of mine dewatering	✓ Bollin and Dean at Cheadle, Mersey Tame and Goyt	Not known (see Table 2-2)	Bramhall, Cheadle, Stockport, Bradbury, Reddish. Town Centres and Surrounds.	Potential conflicts in Stockport due to fluvial floodplains and development. Pluvial and Sewer flooding issues.
Tameside	Not known (see Table 2-2)	✓ Longdendale, Audenshaw, Stalybridge, Ashton, Dunkinfield	Not known (see Table 2-2)	✓ Tame at Mossley, Stalybridge and Ashton	✓ Peak Forest Canal, Breached Banks. Audenshaw Reservoir	Droylsden, Ashton-under-Lyme, M67 Gateway, Stalybridge, Mossley, Hyde, dispersed windfall sites	Ashton-under-Lyme, Mossley and Stalybridge. Affected by flooding from Tame. Urban and dispersed sites affected by potential pluvial and sewer flooding. Residual Risks from Audenshaw Reservoir.
Trafford	Not known (see Table 2-2)	✓ Altrincham, Flixton and Hale, Urmston	✓ Groundwater levels rising following cessation of mine dewatering	✓ Mersey at Flixton, Sale and Altrincham. Sinderland and Timperley Brook at Altrincham and Sale.	✓ Ship Canal, Bridgewater Canal	Trafford Park Inner Area, Wharfside (Regional Centre), Carrington and Partington, Altrincham (Broadheath), Sale. Possible Eco Town near Carrington.	Trafford Park Inner Area, Wharfside Carrington and Partington as a result of Ship Canal. Sale and Altrincham residual risks from Bridgewater Canal
Wigan	✓ Wigan, Leigh, Standish, Golbourne, Hindley	✓ Standish, Wigan, Ashton-in-Makerfield, Leigh	✓ Groundwater levels rising following cessation of mine dewatering	✓ Douglas at Wigan, Croston, Appley Bridge. Glaze at Leigh	Not known (see Table 2-2)	Standish, Orrel, Wigan, Ashton in Makerfield, Leigh, Hindley Green, Bickershaw	Wigan due to Douglas and Sewer Flooding. Leigh due to Glaze Brook and Sewer Flooding. Leeds - Liverpool Canal residual risks through Wigan and Leigh.

5.3 Impacts on and from other strategic spatial considerations

5.3.1 Green Infrastructure Scoping Study

The Greater Manchester Green Infrastructure Scoping Study is currently being undertaken by AGMA. One of the aspects of the study has been to identify potential areas for flood storage based on the proportion of built-up and impermeable areas that intersect fluvial floodplains. Draft maps have identified the River Mersey corridor as being already relatively free of buildings and impermeable areas. Similarly, areas upstream of Salford on the Irwell (near Prestwich) have also been identified. It is important that opportunities are sought to identify areas of floodplain reinstatement in conjunction with the Green Infrastructure Study that may not only have flood risk benefits, but also ecological and environmental improvements. The outputs from the study should be used to inform the SFRA during the next update.

5.3.2 Strategically Important Utilities and Emergency Services

As the EA review into the Summer 2007 floods[22] has highlighted, much of the vital public infrastructure, such as roads and railways, police and fire services, health care and critical utilities in the country are poorly protected from flooding. In particular, water and electricity supplies were shown to be extremely vulnerable in some cases, with widespread water shortages and the potential for extensive power cuts. Sewage treatment works were also badly flooded resulting in untreated effluent being carried by flood waters to surrounding communities.

The impacts of the floods on these critical utilities questioned the effectiveness of the Civil Contingencies Act to plan for and respond to flood events and in recommendation 19, the EA have suggested that:

> *"The government should put measures in place to ensure that key utilities and public services take responsibility for protecting their assets and facilities appropriately. We propose that all public authorities and all private sector utilities that provide essential public services should have a duty under the forthcoming Climate Change Bill, in line with those for Category 1 and 1 responders under the Civil Contingencies Act, to take account of future climate change impacts when providing their services."*

Due to the sensitivity of the data, information as to the flood risk of strategically important utilities and emergency services cannot be released into the public domain. However, within the AGMA sub-region, councils should consider the location of new critical infrastructure in light of flood risk when formulating policies and development guidance. Where large areas and sites are proposed that may require additional infrastructure and utilities provision, a more detailed assessment of flood risk will be necessary either at a Level 2 SFRA, or at site specific flood risk assessments.

Part of the residual risk assessment of a Level 2 SFRA or site specific FRAs should be to identify, in collaboration with emergency planning departments, the strategically important access and egress routes into flood risk areas to ensure that emergency services can reach these areas during a serious flood event. These considerations are already taken into account in areas such as Lower Broughton in Salford.

[22] Review of 2007 Summer Floods, Environment Agency, December 2007

5.3.3 Major Infrastructure Projects

Other major spatial considerations include improvements to the motorway and transport network within the Greater Manchester Sub-Region. The Highways Agency (HA) M60 ten year strategy includes ongoing widening and junction improvements that may impact on flood risk where temporary and permanent works either fall within the floodplain or cross rivers and minor watercourses. In addition, increased runoff from the larger roads may also increase flood risk in areas. There are some ambitious infrastructure schemes planned in the south of the sub-region including the South East Manchester Multi Modal Study (SEMMMS). SEMMMS includes the South East Manchester Relief Road scheme jointly proposed by Cheshire County Council, Manchester City Council and Stockport Metropolitan District Council. Again, the proposed relief road has the potential to increase flood risk as a result of increased runoff and interference with local watercourses and floodplains.

The Leigh Guided Busway and Metrolink Extensions are also envisaged across the sub-region and, again, the effects these projects may have on flood risk needs to be considered, especially with regard to impeding floodplain flows, or the impacts on the wider transport network should they be flooded. The proposed Metrolink extensions in Trafford Park for example passes near the Manchester Ship Canal for which the flood risk is currently unknown. However, there still remains a potential for flooding and therefore impacts on the new route.

5.3.4 Impacts of Flooding on Contaminated & Licensed Waste Sites

When floodwaters flow through contaminated areas or sites containing hazardous materials, the impacts can be very serious. Contaminants can be carried downstream and re-deposited on floodplains posing a significant risk to public health. Similarly, contaminants can seriously affect the ecology both locally and, potentially, a significant distance downstream. Therefore, at a strategic planning level, it is important to recognise where this risk may be and to take a precautionary approach to allocating surrounding land for development.

There are a total of 18 COMAH (Control of Major Accident Hazards) registered sites within the Greater Manchester Sub-Region and a further 436 general waste sites. COMAH sites represent the greatest source of potential contamination or pollution risk. There are three COMAH sites at risk of fluvial flooding in Trafford, Manchester and Wigan (Table 5-4 and Figure A-14, Appendix A).

The exact impacts of contaminant transport in terms of concentration and carrying distance is unknown at present. However, there still remains a residual risk that needs to be borne in mind when allocating land for development. For example, the COMAH site at risk in Trafford is in Flood Zone 2 of the River Mersey and also potentially at risk from the Ship Canal. It is located near a potential development area at Carrington. Similarly, the COMAH site in Manchester is located within the Inner Area and borders the Regional Centre.

In addition, there are a further 36 transfer stations, recycling plants, non-hazardous landfills and Metal/ELV works sites all shown to be at risk of flooding. Although not as hazardous, the local transportation of debris and pollution also needs to be taken into account when allocating sites for development.

Table 5-4: List of COMAH Sites Potentially at Risk of Flooding in Greater Manchester

COMAH Site	District	At Flood Risk?	Nearest Watercourse	Areas Impacted DS
Nova Chemicals (Europe) Ltd, Carrington	Trafford	Yes, Partial - FZ2	500m - River Mersey	Potential for contaminant transport downstream and into Ship Canal impacting on urban areas and wildlife habitat.
TRANSCO, Bradford Rd, Miles Platting	Manchester	Yes, Partial - FZ3a and FZ2	70m - Ashton Canal. 150m - River Medlock	Potential for contaminant transport downstream into Ashton Canal and River Mersey impacting on urban areas and wildlife habitat.
TRANSCO, Darlington Street, Wigan	Wigan	Yes, Partial - FZ3a and FZ2	10m - River Douglas	Potential for contaminant transport downstream into River Douglas impacting on urban areas and wildlife habitat.

5.4 Properties and Populations Affected by Flooding

5.4.1 EA Flood Risk Ranking – Properties Affected by Flooding

The EA carried out a strategic review of flood risk for the whole of the North West Region[23]. This looked at the EA Flood Zones and the number of properties at risk of flooding within each District in the North West. Using this information, together with future development targets (now updated following the EiP Panel Report), a flood risk ranking was developed for the whole region and a level of flood risk (low, medium or high) was applied to each District (Table 5-5 and Figure 5-2) based on the EA Flood Zone 2 and Flood Zone 3 outlines only.

Table 5-5: Summary of EA Flood Risk Ranking Results for AGMA Districts

District	EA Level of Flood Risk	Properties in Flood Zone			Total Properties
		FZ3	FZ2	FZ2+3	
BOLTON	LOW	947	503	1,450	122,361
BURY	LOW	288	4,748	5,036	84,002
MANCHESTER	HIGH	10,499	5,820	16,319	211,982
OLDHAM	MEDIUM	485	553	1,038	98,524
ROCHDALE	MEDIUM	2,093	1,430	3,523	94,489
SALFORD	HIGH	10,233	2,244	12,477	108,532
STOCKPORT	MEDIUM	3,399	1,057	4,456	131,070
TAMESIDE	LOW	631	444	1,075	101,374
TRAFFORD	MEDIUM	762	1,815	2,577	100,958
WIGAN	MEDIUM	3,888	4,027	7,915	140,832

[23] Environment Agency Flood Risk Ranking For North West Region, Report to Support the Production of A Regional Flood Risk Assessment (Version 4, 2nd October 06)
[12]Figure includes an area in the south east of the District which is the planning responsibility of Peak District National Park

The study shows that once again Manchester and Salford have the highest level of flood risk. Although the EA study examined numbers of properties at risk, it did not examine populations affected by flooding.

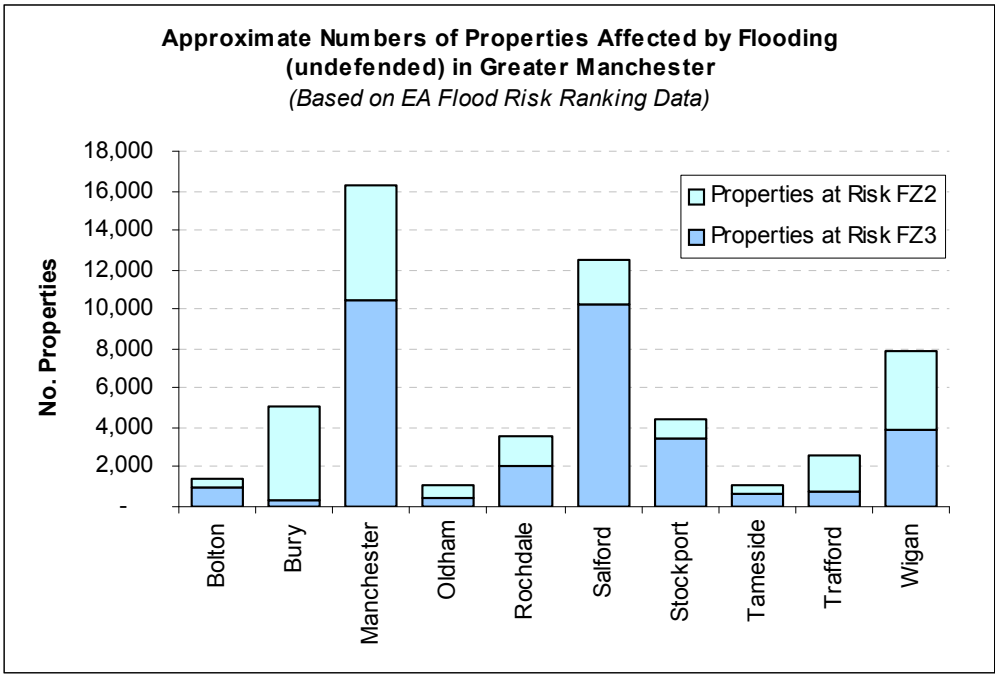


Figure 5-2: Properties at Risk of Flooding in Greater Manchester.

5.4.2 2001 Census and 2006 Mid-Term Population Estimates

To further refine the flood risk ranking for the AGMA Districts and to allow strategic planners to identify the numbers of people that may be affected by flooding in each District, it was necessary to undertake an analysis of populations at risk. This is not a straightforward exercise as the actual population of areas within any the District at any one time is not known.

Therefore, a number of assumptions need to be made. Firstly, Output Areas (OAs) from the 2001 census obtained from the National Statistics Office were used to identify the population distribution in 2001 across the AGMA sub-region. OAs are the smallest area that census statistics are gathered for and for the Greater Manchester Area, there are 8,358 ranging in area from 0.2 Ha to 2,498 Ha depending on the density of the urban area (Figure A-12, Appendix A).

The 2006 Mid-Term population estimates for each District were compared against the 2001 census results and the ratio between the two was applied to the 2001 OA populations. This of course assumes that the population estimates within a District for 2006 are distributed as they were in 2001. Assuming an equal distribution of population across an OA, a population density was derived by dividing the population by the OA area (Figure 5-3 and Table 5-5).

The SFRA Flood Zones were then overlaid onto the OAs and the resulting intersecting areas were multiplied by the population density to obtain an approximate population affected by flooding. It should be noted that these figures are an estimate based on the proportion of the OA area covered by a flood zone. Therefore, it is assumed that the population within an OA is evenly distributed. Although this is a basic estimate, across all OAs within the sub-region, it provides an indication as to the potential population that may be affected by fluvial flooding. The Census data also provides a break down of the population within an OA by the type of accommodation they live in. Again, assuming an even distribution across an OA, an indication as to the predominant types of properties at risk can be shown.

These estimates are based on fluvial flood risk only and do not take into account the potential numbers of properties or populations affected by other sources of flooding, including the potential risk posed by Manchester Ship Canal. Following completion of more detailed district-level studies, it is recommended that these figures are re-visited to include, where possible, the population and numbers of properties at risk of flooding from other sources.

From this analysis it is clear that Manchester CC, Salford CC and Wigan MBC currently have the greatest populations affected by flooding. This concurs with the fact that they also have the highest population densities in the sub-region and the greatest areas of land at risk of fluvial flooding. Stockport and Trafford also have a substantial population and number of properties at risk of flooding.

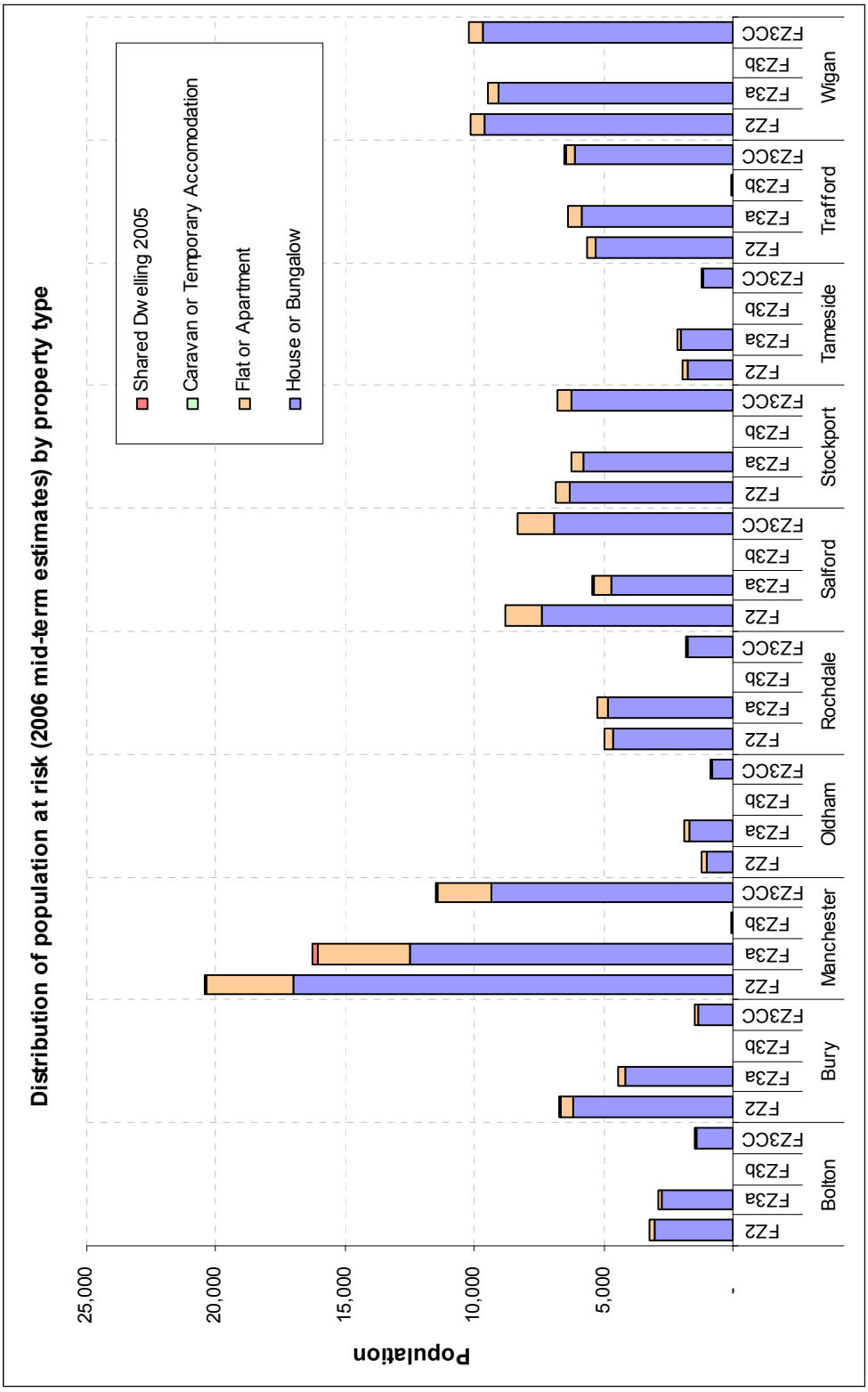


Figure 5-3: Approximate Population at Risk of Flooding in Greater Manchester (May 2008 FZs used).

Table 5-6: Summary of Populations at risk in each Fluvial Flood Zone (May 2008) and by type of property

LA	Fluvial Flood Zone	Population at Risk (2006)	House or Bungalow	Flat or Apartment	Caravan or Temporary Accommodation	Shared Dwelling 2005
Bolton	FZ2	3,198	3,015	179	4	1
	FZ3a	2,916	2,763	151	1	0
	FZ3b	4	4	0	0	0
	FZ3CC	1,472	1,422	50	1	0
	Total	7,591	7,204	380	6	1
Bury	FZ2	6,692	6,174	506	12	-
	FZ3a	4,457	4,140	313	4	-
	FZ3b	6	5	0	0	-
	FZ3CC	1,465	1,369	95	1	-
	Total	12,620	11,688	914	18	-
Manchester	FZ2	20,462	17,019	3,339	13	91
	FZ3a	16,258	12,497	3,532	21	208
	FZ3b	36	31	5	0	0
	FZ3CC	11,498	9,359	2,052	5	82
	Total	48,255	38,906	8,928	40	381
Oldham	FZ2	1,234	1,023	207	2	1
	FZ3a	1,885	1,701	179	1	3
	FZ3b	3	3	0	0	0
	FZ3CC	884	783	99	1	1
	Total	4,005	3,510	486	3	5
Rochdale	FZ2	4,971	4,634	327	3	8
	FZ3a	5,238	4,812	414	7	5
	FZ3b	9	8	1	0	0
	FZ3CC	1,822	1,721	98	2	1
	Total	12,040	11,175	840	11	14
Salford	FZ2	8,836	7,412	1,391	27	5
	FZ3a	5,432	4,729	643	60	1
	FZ3b	6	5	1	0	0
	FZ3CC	8,339	6,937	1,369	27	5
	Total	22,613	19,083	3,404	114	12
Stockport	FZ2	6,839	6,311	526	1	1
	FZ3a	6,263	5,775	481	2	3
	FZ3b	11	10	1	0	0
	FZ3CC	6,771	6,276	493	1	1
	Total	19,883	18,372	1,502	4	5
Tameside	FZ2	1,961	1,725	226	7	3
	FZ3a	2,180	2,011	161	8	0
	FZ3b	5	5	0	0	0
	FZ3CC	1,186	1,114	65	7	1
	Total	5,333	4,856	452	22	4
Trafford	FZ2	5,649	5,297	350	2	0
	FZ3a	6,390	5,823	567	0	0
	FZ3b	41	36	5	0	0
	FZ3CC	6,487	6,112	373	2	0
	Total	18,567	17,269	1,294	3	0
Wigan	FZ2	10,145	9,581	557	4	3
	FZ3a	9,478	9,052	414	10	2
	FZ3b	28	27	1	0	0
	FZ3CC	10,238	9,672	559	4	3
	Total	29,889	28,333	1,531	18	7

***Note**: FZ3a refers to the area outside FZ3b. Likewise, FZ3CC and FZ2 refer the areas outside FZ3a.*

One of the purposes of the proposed scale and quantum of future development is to house projected increases in population within the sub-region. However, a potential conflict between flood risk and development is presented again within the Districts where the largest RSS housing targets are proposed namely, Manchester, Salford, Trafford and Wigan. Given the more vulnerable status given to residential development in PPS25 and the regionally important development areas, it is essential that meeting the RSS targets does not lead to a greater population being affected by flood risk.

As stated above in Section 4.3.4, there is presently an unquantified risk of flooding from the Manchester Ship Canal. Therefore, there are potentially more people and property currently at risk that live in areas abutting the Canal. Added to this, there is significant development proposed for areas adjacent to the canal in the Western Gateway and Regional Centre in Salford and also the Partington, Carrington, Trafford Park and Wharfside areas in Trafford.

For councils to the north and south of the Manchester City Region, there are currently less identified properties and populations affected by fluvial flood risk, however, the risk posed to properties and populations from other sources is still unquantified. It is anticipated that uncertainty in these areas can be reduced during the course of more detailed studies, including Level 2 assessments. As stated above in Section 5.1, development within these Districts needs to be carefully planned to avoid increasing the flood risk to existing and future populations and property both locally and further downstream.

5.5 Strategic Effects of Flood Defence Failure

5.5.1 Local Effects and Impacts

Behind defended areas there is a residual risk or flooding, primarily through overtopping of defences and breaching or structural failure of defences. Such failure of defences can lead to rapid and deep inundation as areas behind defences are low lying and the water level will have often built up to a higher level than ground levels of the defended area.

For example, some of the main defended areas at risk within Greater Manchester are Lower Kersal and Lower Broughton in Salford. The Salford City SFRA identifies these areas to be at risk of high velocity flood water flow should defences breach. This is due to a large hydraulic head driving water though a breach which has the potential to move large and heavy objects such as vehicles and knock people off their feet. Areas in Lower Broughton are vulnerable to deep inundation due to ponding of water in sites of very low elevation. This can cause extreme damage to property and potentially put people at risk of drowning. The aforementioned SFRA identified that flood depths of up to 3.75m are possible in areas of Lower Broughton, Lower Kersal and Charlestown. Falling in the Central Salford Inner Area, these are areas of strategic importance to Salford and the sub-region as a whole and therefore flood defence failure may have wider economic implications and disruptive knock effects.

Throughout the sub-region there are numerous raised defences protecting development. Each one of these defended areas carries an inherent residual risk of flooding. This is an important consideration to take into account when seeking to allocate development sites within defended areas or when examining proposals to defend new development. The potential inundation areas, velocities and depths of flooding need to be determined so that appropriate access and egress arrangements can be put in place and that buildings within defended areas can be designed and built with flood resilience in mind. The residual risk of flooding to these sites needs to be defined

clearly within site specific FRAs together with evidence of exception testing as described in PPS25.

5.5.2 Sub-regional Effects and Impacts

The effects of defence failure in one area can be devastating to local communities. However, it is important to consider the impacts of that failure on other areas and Districts further downstream. Raised defence failure may actually increase the storage capacity within the area as the natural floodplain comes into use. This can have the effect of reducing the impact of a flood event further downstream by attenuating the flood hydrograph and increasing upstream storage. It is likely however, that a single failure will only have a local effect. As identified in Section 5.3.4, should defences protecting contaminated land, landfills or sites holding polluting or contaminating material fail, there could be detrimental impacts downstream.

The failure of flood storage schemes can have more a significant strategic effect across the sub-region. Should a storage scheme fail, there is the potential for large volumes of water to be released rapidly into the catchment. This is more of a risk with "inline" storage schemes where raised banks are built across a watercourse, effectively creating a dam during a flood event. For "offline" and lateral storage schemes or washlands (managed floodplains), water could only be released into the catchment once the flood peak had passed, thereby prolonging the recession of the flood event.

5.6 Identifiable Strategic Mitigation Measures

5.6.1 Flood Storage

Strategic options for mitigation include additional upstream flood storage and washland creation schemes. On a strategic catchment-wide scale, appropriately located flood storage basins and washlands can not only contribute to a reduction in flood risk, but can also enhance and contribute to wetland restoration and habitat creation as well as potentially increasing the recreational value of many river corridors. For upstream flood storage schemes to maximise benefits downstream, they need to be located in suitable areas of the catchment. Locating flood storage basins too high in the catchment could mean that a large proportion of a flood event is still able to travel downstream from other areas in the catchment. For example, the Irwell CFMP assessed the possibility of locating flood storage basins in the upper catchment including:

- Headwater storage in the Upper Croal catchment on Eagley Brook, Bradshaw Brook and Astley Brook;
- Headwater storage in the Upper Roch catchment including the Beal and other small tributaries;
- Washland areas to the west of Heywood in Rochdale;
- FSAs between Ramsbottom and Bury on the Irwell.

The Irwell CFMP concluded that carrying out the storage schemes individually would have limited effect on catchment wide flows, levels and damages. By carrying out the schemes collectively, flood levels in Heywood and Bury reduce by 0.2m to 0.4m, 0.6m at Radcliffe and 0.3m at Salford resulting in a reduction in catchment-wide damages of 15-21%. As a result of their relatively high placement in the catchment, the schemes have limited benefits to areas further downstream in Bury, Manchester, Salford and Trafford especially once the effects of climate change have been taken into account.

However, locating flood storage facilities in the mid-catchment areas between Bury and Salford could have more significant benefits. According to the Irwell CFMP, providing up to 2.4M m^3 of storage volume on the Irwell upstream of Salford could reduce levels in Salford by up to 1m, resulting in a reduction in damages of 30-40%. The Salford City SFRA identifies the "Castle Irwell Basin" (as described in the EA Lower Irwell Flood Risk Management Strategy) and the Irwell CFMP refers to it as one of the only suitable sites in the Irwell catchment that will have a significant strategic impact on reducing flood risk. As a result, Salford CC and the EA are seeking to explore the scheme in more detail, though the costs of the project are expected to be very high.

In the Tame, Goyt and Mersey Policy Units (PUs 3-6) presented in the Draft Upper Mersey CFMP, there are suggestions for flood storage areas and washlands at the Tame and Mersey and the Goyt and Mersey Confluences, on the Goyt at Goyt Hall Farm, Marple Dale and Brabyns Park, and on the Tame at the golf course south of Woodhouse. These are all located upstream of Trafford in Stockport and Tameside. As a result of implementing these schemes, the CFMP suggests that:

- the fluvial flood risk to people in properties falls by 74%
- the fluvial flood risk to property alone falls by 7%
- economic damages falls by 28%
- and agricultural risk falls by 14%.

The CFMP also took into account the implications of future flood risk on these scenarios and concluded that by implementing these washlands and flood storage basins, benefits could be realised to 2050 and beyond. These are strategic schemes as, although they are based in Tameside and Stockport, they provide benefits to all Districts downstream. Following the publication of the Final Upper Mersey CFMP, it is recommended that AGMA should consider pursuing the FSA proposals in more detail in partnership with the EA.

To meet the costs of the Castle Irwell Basin, and other catchment and AGMA wide flood risk management options, it may be necessary for AGMA to adopt and implement a local tariff-based system into the local development plan process of each council. This would allow funds to be raised from new developments that fall into potential flood risk areas. The system could also be run on the sub-regional basis to fund large flood risk mitigation/management schemes across the Greater Manchester area.

Furthermore, and working closely with the outputs from the current sub-regional Green Infrastructure study, careful landuse planning and the gradual reinstatement of green open spaces together with wetlands and woodlands throughout the catchment will help to reduce runoff, identify, restore and create floodplains which further reduce the cumulative flood risk across catchments.

5.6.2 Sustainable Drainage Systems - SuDS

5.6.2.1 What are SuDS?

SuDS are typically softer engineering solutions inspired by natural drainage processes such as ponds and swales which manage water as close to its source as possible.

Wherever possible, SuDS techniques should seek to contribute to each of the three goals identified below, with the preferred system contributing significantly to each objective. SuDS solutions for specific sites should seek to:

- Reduce flood risk (to the site and neighbouring areas),
- Reduce pollution, and,
- Provide landscape and wildlife benefits.

These goals can be achieved by utilising a management plan incorporating a chain of techniques, (as outlined in Interim Code of Practice for Sustainable Drainage Systems 2004), where each component adds to the performance of the whole system:

- Prevention: good site design and upkeep to prevent runoff and pollution (e.g. limited paved areas, regular pavement sweeping)
- Source control: runoff control at/near to source (e.g. rainwater harvesting, green roofs, pervious pavements)
- Site control: water management from a multitude of catchments (e.g. route water from roofs, impermeable paved areas to one infiltration/holding site)
- Regional control: integrate runoff manage from a number of sites (e.g. into a detention pond)

5.6.2.2 Why use SuDS?

Traditionally, built developments have utilised piped drainage systems to manage surface water and convey surface water run-off away from developed areas as quickly as possible. Typically these systems connect to the public sewer system for treatment and/or disposal to local watercourses. Whilst this approach rapidly transfers surface water from developed areas, the alteration of natural drainage processes can potentially impact on downstream areas by increasing flood risk and reducing water quality.

Due to the difficulties associated with upgrading sewer systems it is uncommon for sewer and drainage systems to keep pace with the rate of development/re-development and the increasingly stringent drainage discharge restrictions that are being placed upon them. As development continues and/or urban areas expand, these systems can become inadequate to deal with the volumes of surface water that is generated, resulting in increased flood risk and/or pollution to watercourses. Allied to this are the implications of climate change and increasing rainfall intensities.

5.6.2.3 SuDS in the Sub-Regional Context

Further strategic flood risk mitigation options include the implementation of common policies on SuDS throughout the AGMA sub-region. Consistent policies across the sub-region would ensure that, where possible, runoff from new development within a whole catchment is reduced therefore contributing to more sustainable flood risk management across several councils. Given the permeable bedrock and superficial geological conditions of areas in Manchester, Salford, Stockport, Trafford and Wigan, infiltration SuDS are likely to be most suitable for new development, however the risk of contaminating the underlying aquifers needs to be seriously considered. The less permeable nature of other areas in the sub-region, including Bolton, Bury,

Rochdale, Oldham and Tameside means that attenuation systems might be the most suitable SuDS method (See Figures A-2 to A-4 in Appendix A).

Other methods of reducing runoff from increased development should also be investigated, especially in heavily urbanised areas. These include the provision of green roofs, onsite attenuation such as storage ponds incorporated into landscaping or, on a smaller scale, water butts and rainwater harvesting. Should each of the 173,200 homes in the sub-region incorporate small-scale, individual SuDS in addition to larger, site or area scale SuDS, the potential attenuation effects and reduction in runoff could be substantial.

One of the issues with some SuDS methods is that they need to be maintained so that they continue to operate efficiently. There is, in some cases, disagreement between developer, local authorities and utility companies as to who will be responsible for maintenance and operations of certain SuDS methods once a site has been developed and sold. To avoid such disagreement or confusion in the future, it is recommended that investigation into responsibilities is carefully researched so that the implementation of consistent AGMA policies on SuDS can also provide guidelines or general conditions as to who will be responsible for maintaining SuDS on new development.

SFRA Position Statement	**May 2008**
SuDS	
AGMA have commissioned a sub-regional SuDS map that will make use of geological data (soil, superficial deposits and bedrock), permeability data (soil, superficial deposits and bedrock) and groundwater protection data (groundwater vulnerability and source protection zones). This will assist in the production of an AGMA-wide SuDS policy, strategic planning and development control activities. The map is due to be complete in the Summer of 2008.	

6 Summary Conclusions & Recommendations

6.1 Summary

A sub-regional overview of planning policy and flood risk was undertaken for the Greater Manchester Area. The planning policy and flood risk reviews were carried out in parallel with the outputs being brought together in an overall strategic overview of flood risk for the AGMA sub-region.

Flood related planning policy at a national, regional and District level was collated, reviewed and summarised in relation to the SFRA. This serves to highlight the fact that flood risk is taken into account at every level within the planning process and also helps to demonstrate how the SFRA will feed into LDF process and Core Strategy Timetable of each council, which shows that by 2010, all of the councils are looking to have their LDF adopted.

Future development patterns for the sub-region were also determined from the RSS and each of the councils. A development map (Figure 3-1) has been produced that highlights the broad potential development areas according to the proposed changes to the EiP recommendations to the Draft RSS. This pattern of development can be used at a high level to demonstrate where conflicts between future development pressures and flood risk may exist. The Manchester City Region is a nationally and regionally important centre and, as a result, is the primary focus of future development within the sub-region. This is recognised within the Draft RSS (EiP panel recommendations) with Manchester CC, Salford CC and Trafford MBC being allocated 59% of the total for AGMA. Outside of the City Region to the north and south, broad-scale development is expected to occur within identified HMRs and the main towns and their surrounds. In addition, identified brownfield sites outside of the towns may also be developed.

The overall hydrology of the Greater Manchester Sub-Region was summarised and put into context for each of the ten Districts. The River Irwell and the Mersey catchments and sub-catchments dominate the sub-region making up a total of 78% of the total AGMA area with Glaze Brook, the River Bollin, Sinderland Brook and the River Douglas making up the remaining 22%. The upper regions of the catchments tend to be steeper and, due to their geological make up, less permeable and therefore more susceptible to flooding from watercourses and direct runoff as a result of high intensity rainfall events. The lower areas of the catchments consist of a more shallow topography, more permeable geology and tend to be dominated by fluvial flooding as a result of widespread and persistent rainfall events. All catchments within the AGMA sub-region, apart from the River Douglas, drain into the Manchester Ship Canal.

Schematics for each District were developed that highlight how they are hydrologically connected to one another. RSS housing targets have been added and the cumulative effects of upstream development assessed. Being at the downstream extents of the sub-region and having significant housing targets, Manchester, Salford and Trafford are potentially most vulnerable to flood risk and the development actions of all of the other AGMA Districts.

The main source of flood risk policy and strategy within the sub-region are catchment flood management plans. The four relevant CFMPs shaping flood risk management, guidance and strategy covering the AGMA Districts are the River Irwell CFMP, the Draft River Douglas CFMP, The Draft Upper Mersey CFMP and the Draft Mersey Estuary CFMP. As well as highlighting the flood risks within a catchment, CFMPs also outline policies for dealing with flood risk management at locations within a catchment. There are six generic CFMP policies that summarise flood risk management options ranging from no active intervention to managed flood storage and

attenuation. Due to the urban extent of the sub-region, it is perhaps not surprising that there is a bias toward maintaining existing flood risk management activities and reducing overall future flood risk to the Greater Manchester Sub-Region.

Salford City Council has already carried out a SFRA (compliant to PPG25), which it completed in November 2005. The SFRA provided a comprehensive overview of flood risk to specific development zones within the District. Detailed two-dimensional modelling was undertaken to determine the depth and velocity of flooding to these areas. Since the release of PPS25, however, there are a number of points that the SFRA does not address. These include identification of the functional floodplain – Flood Zone 3b, allowances for climate change as defined in PPS25 and the fact that only part of the District was covered.

PPS25 requires that as part of any SFRA, all sources of flooding are identified. The Greater Manchester Sub-Region has a long history of flooding. From this record and using other sources of flood risk information, five main sources of flood risk were identified: flooding from rivers, flooding from sewers, flooding from the land, groundwater flooding and flooding from man-made and artificial sources. River flooding was found to be the most significant source in the sub-region in terms of recorded events and numbers of properties affected. In addition to open channel watercourses, culverted and "hidden" watercourses present an additional fluvial flood risk. Flooding as a result of culverts can occur due to siltation (and lack of capacity), debris blockage and collapse. This can lead to flooding even during relatively minor events and cause disruption to properties and transport links.

Using flood zones created from EA detailed flood outlines, historical flood outlines and broad-scale flood outlines, Trafford, Wigan, Manchester and Salford were found to have the largest areas affected by flooding. These four authorities also have the highest housing and economic targets under the RSS.

Whilst river flooding poses a significant risk to the sub-region, the impacts of other sources of flooding should not be underestimated or diminished. Smaller events from other sources that occur much more frequently can cause significant problems to properties and transport links and must therefore also be taken into account. Records of pluvial flooding exist in areas of the sub-region especially those Districts located in the upper catchments (Bolton, Bury, Oldham, Rochdale and Wigan) though the exact extent and magnitude of these events is not known.

Sewer flooding was identified using historical records from United Utilities DG5 database (June 2007), the councils and the EA. It is clear that sewer and drainage flooding pose a significant risk to many urban areas within the sub-region. Manchester, Salford, Trafford and Wigan were found to have the greatest number of recorded sewer flood events. However, the future risk of flooding posed by sewers and their capacity is presently unknown. The foundations for a future working partnership between UU and AGMA have been established through the integrated Urban Drainage Pilot Study (including Salford City Council the EA and other partners). However despite this joint work, it looks unlikely that UU will agree to the release data it holds on flood risk from the public sewer network due to data protection/sensitivity concerns.

However, UU have previously agreed to examine 45-50 planned development sites for each AGMA district and provide feedback on the risk of sewer flooding, water infrastructure and future capacity.

No records of groundwater flooding were found during the course of the study. However, there are major aquifers with more permeable superficial deposits overlying them within the AGMA sub-region. Following cessation of mine dewatering in the region, groundwater levels have been rising

and there may be a potential for groundwater flooding to affect basements and underground car parking facilities in certain areas around Manchester, Trafford and Salford.

With its industrial heritage, there are numerous artificial (man-made) waterways and reservoirs within or contributing to the AGMA sub-region. The canal network is managed by British Waterways, the Manchester Ship Canal Company and private owners. There are recorded incidents of flooding from the canal network in Greater Manchester, including the Ship Canal into which the entire Irwell, Mersey, Glaze and Sinderland catchments drain. Flood risk from the Ship Canal is currently undefined and unquantified and represents a significant and critical "gap" in knowledge for the sub-region. Given the regional importance of potential regeneration and new development along the Ship Canal in Manchester, Salford and Trafford, it is essential that the flood risk posed by the canal is identified. The EA are currently reviewing and converting a hydraulic model of the Ship Canal into a flood risk model. The outputs of the model are expected in Spring 2009.

Similarly, there are approximately 80 reservoirs falling under the Reservoirs Act within the AGMA Districts with up to an additional 45 contributing to them from outside the sub-region. Again, there are few recorded incidents of flooding as a result of reservoirs, though the residual risk of breaching and overtopping remains along with the risk associated with emergency discharges. The Districts most at risk are those in the upper catchment areas, where the majority of reservoirs exist. These include Bolton, Bury, Bolton, Oldham, Rochdale, Tameside and Stockport (see Figure A-1 in Appendix A).

Due to the history of flooding in the sub-region, there are numerous structures, embankments and washlands (either purpose built or natural) that contribute to catchment flood risk management. The EA maintain and keep records of many of the defences in the sub-region, though it should be noted that there are a great deal more "private" or "non-maintained" structures and embankments that provide a level of protection to areas. These are monitored by the EA using NFCDD, but the standard of protection, level of maintenance and their condition is, in many cases, unknown. Therefore, potential development near these assets needs to take this into account during site specific FRAs.

The standard of protection for defences within the sub-region varies markedly, however the greatest proportion provides a level of service of between 25 and 50 years with Rochdale, Stockport, Bury and Bolton having more assets with a standard of protection of between 50 and 100 years. It must be noted that these figures are based on NFCDD data, which has a default value of 50 years for SoP. A proper assessment of SoP is therefore required during more detailed assessments of potential development areas or site specific FRAs.

As the CFMPs have all stated, locating and providing strategic flood storage in upstream areas can potentially provide protection to areas much further downstream. At present, there are five formally maintained flood storage areas in the sub-region. Locating flood storage areas too high in a catchment only tends to have local benefits and do not have the capacity to provide wider catchment-wide reduction in flood risk. These are all located in middle to lower catchments.

Using information and analysis gathered during the planning policy and flood risk reviews, a strategic overview of flood risk was carried out to identify potential conflicts between development pressures and flood risk now and in the future.

The North West Regional Spatial Strategy defines development targets for the sub-region to 2021. Manchester, Salford and Trafford form parts of the Regional Centre and are therefore of strategic importance to the region. As a result, their combined RSS housing targets form 59% of total for the entire sub-region. In addition to this, significant economic development is proposed within the

Inner Areas and Regional Centre. The councils also have some of the largest population densities, properties and areas affected by fluvial flood zones, sewer flooding and, at present, an unquantified risk of flooding from the Manchester Ship Canal and the public sewer network.

An increased level of flood risk is expected to affect the sub-region over the next 50 to 100 years as a result of climate change. Firstly, as a result of wetter and warmer winters, an increase in large fluvial flood events is likely to affect the larger rivers and watercourses in the sub-region, including the Irwell and Mersey. Secondly, extreme rainfall events are likely to become more frequent leading to greater storm intensities. This is likely to lead to great deal more runoff causing pluvial flooding and overwhelming of the urban sewer networks in particular. Some scenarios have an increase in rainfall of 56% by 2080, leading to an increase in runoff of 82%.

Strategic flood risk management measures include upstream flood storage. Flood storage areas (FSAs) too high up in catchments tend to provide only local benefits and therefore, from a strategic point of view, the most suitable areas tend to be middle and lower catchments. FSAs have been identified in Bury, Stockport and Tameside that have the potential to provide significant benefit to areas downstream, including the Manchester City Region.

The use of Sustainable Drainage Systems is becoming more important. In addition to the more usual attenuation and infiltration systems, providing more 'green' spaces within the urban environment can also help to reduce runoff and also increase wildlife habitat. These areas can be sometimes be most effective when placed alongside development in water corridors (e.g. along canals).

6.2 Recommendations

Given the national and regional importance of the Manchester City Region and focus of development within the regional centre (Manchester Salford and Trafford), it forms the main focus of economic and housing growth in the sub-region. Development surrounding the MCR is smaller in scale, but is important to regenerate deprived areas and encourage local economic growth.

The SFRA has identified significant flood risk to areas in the sub-region and Manchester, Salford and Trafford appear to have the greatest potential risk. The three councils also have (collectively) the greatest number of properties and populations at risk and, as mentioned above, the largest development targets in the sub-region. A significant potential conflict exists in these councils between development pressures and level of flood risk. Other areas where conflicts may arise are in Bury, Rochdale, Stockport and Wigan.

Large areas of uncertainty in flood risk still remain, including the Manchester Ship Canal and pluvial and sewer flooding. As mentioned in the report, it is hopeful that data defining flood risk from the canal will be provided by the EA by 2009. However, the availability of sewer flooding information from the public sewers is unlikely to come forward from UU. Given this, it is essential that appropriate polices are put in place to ensure that new development and redevelopment takes into account the potential for sewer flooding as part of detailed site specific FRAs during the planning process. For strategic planning purposes, UU have previously agreed to examine 45-50 planned development sites for each AGMA district and provide feedback on the risk of sewer flooding, water infrastructure and future capacity to the development allocations studies.

Given the scale of development, consideration should be given to a Water Cycle Strategy for Greater Manchester. This will identify the water infrastructure pressures and requirements to fully meet the scale of development proposed in the sub-region.

The SFRA has identified that flooding from the land may be one of the most common and disruptive forms of flooding within the sub-region. It is recommended that a Pluvial / Surface Water flood map is created (at a high level) for the whole of the AGMA sub-region. This will help to address a critical data gap and inform planners as to where there are potential surface water flow routes and ponding areas.

The pluvial map could then feed into surface water management plans (SWMPs) for areas within the sub-region. SWMPs are in their infancy and are still being fully defined, but their purpose is to provide a tool to improve the activities between stakeholders involved in surface water drainage.

From a purely theoretical flood risk point of view that would reduce the development and flood risk conflicts in the sub-region, a more even distribution of development across the sub-region would be implemented. However, this is unrealistic and therefore, to address the main risks in the MCR will require the cooperation and participation of other AGMA members.

Mitigation would include upstream flood storage in Bury, Stockport and Tameside. In addition, the use of SuDS across the sub-region may also help to reduce runoff and therefore flood risk both locally and further downstream in the MCR.

This will require 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.

The guidance document could also address potential funding schemes to ensure that strategic flood mitigation measures can be developed and that SuDS methods can be maintained and operated correctly. One such scheme could be an AGMA-wide development levy that would be introduced to developments in areas of flood risk to raise the necessary mitigation and maintenance funds.

To ensure that this SFRA remains up-to-date, it has been classified as a “living document”. This means that the document, or sections within the document can be updated or added to once more information becomes available. To help facilitate this process, a single point within AGMA for the collection and cataloguing of flood risk data relevant to the sub-region should be created – a flood risk library. Flood risk data might include all FRAs completed within the AGMA sub-region, records of flood events and updated flood risk information and studies from the EA and other organisations.

6.3 Next Steps

As stated in Section 2.4, a number of additional studies are currently being undertaken that will fulfil the requirements of a full Level 1 SFRA as described in PPS25. These studies include:

- Plans at a higher resolution (1:10,000) of the AGMA area showing flood risk information, local flood defence outputs and local flood warning and flood watch areas.
- Guidance on site-specific FRAs for all broad-scale development area within individual districts.

- Guidance on SuDS for all broad-scale development areas within a District. This will reflect the current and proposed urban density, geological and soil conditions and suitability of particular SuDS techniques and will be presented as a SuDS map for the sub-region.
- Guidance on undertaking the PPS25 Sequential Test for potential development sites within identified broad development areas as part of a Level 2 Framework.

Using the SFRA and the additional studies (due to be completed summer 2008), each council will undertake the sequential approach to allocating development within their districts. The sequential approach to development and flood risk should be demonstrated through the Sequential Test.

The sequential test is designed, in the first instance, to allocate development within Flood Zone 1 (low probability of flooding). If this is not possible, development can be allocated within Flood Zone 2 (medium probability of flooding) and Flood Zone 3 (high probability of flooding) providing the development 'vulnerability' is suitable. Table D2 from PPS25 highlights the vulnerability classifications, whilst Table D3 in PPS25 summarises which vulnerability classification is suitable for which flood zone.

Following the sequential test, should an allocation still be located within a flood risk area, then a Level 2 assessment will be required for the area to provide sufficient information for the Exception Test to be applied.

It is worth noting that, within PPS25, guidance and examples for the Sequential Test are referred to in the context of Fluvial and Coastal flooding. However, it is recommended that the sequential approach is applied to other sources of flooding too including artificial, surface water and overland flow, sewer flooding and groundwater flooding.

In many instances, local authorities are aware of areas within their districts that are likely to come forward for development within their LDF prior to undertaking the PPS25 sequential test. Flood risk to these areas may have already been fully or partially defined within the sub-regional or Level 1 SFRA.

There may also be instances where the sub-regional SFRA has identified 'gaps' in the flood risk data in potential development areas or, there may be circumstances in which potential development areas are identified after the sub-regional SFRA in locations where flood risk is either missing or required further definition. In these circumstances, local authorities can be better informed of the flood risk to an area if a more detailed Level 2 analysis is carried out prior to sequential testing.

This is not to say that the PPS25 sequential approach should be ignored during the allocation of sites or that the SFRA is being used to justify development within an area. The method can actually better inform the sequential approach recommended in PPS25 and allow local authorities to consider vulnerability of development and flood risk to ensure that sustainable development with minimal flood risk is delivered.

Following the more detailed analysis, the sequential approach is still followed with regards to development within the area(s) of interest and, if necessary, the Exception Test is carried out.

A Level 2 SFRA Framework is currently being produced that will allow councils to identify and specify more detailed studies within their districts as and when necessary. The framework document will also highlight areas where Level 2 studies are required immediately (based on the findings of the SFRA – Table 6-1) together with cost and programme estimates.

Table 6-1: Areas where Level 2 SFRAs are required immediately

District	Area for Level 2 SFRA
Bolton	Horwich Loco Works
Bury	Between Bury and Radcliffe
Manchester	Medlock & Corn Brook – City Centre Chorlton Brook Didsbury and Northendon
Rochdale	Rochdale Town Centre and Heywood
Salford	Manchester Ship Canal
Trafford	Manchester Ship Canal and Bridgewater Canal
Wigan	Wigan Town Centre and Leigh

Appendices

Appendix A – Sub-Regional Maps & Figures

Appendix B – District Summaries

Appendix C – Planning Policy Review Tables

Appendix D – Data Register

Appendix E – Contacts

Appendix A: Sub-Regional Maps & Figures

Appendix B: District Summaries

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