Strategic Flood Risk Assessment for Greater Manchester

Sub-Regional Assessment

Appendix B – Supporting Information

"Living Document" June 2008

Revision Schedule

Strategic Flood Risk Assessment for Greater Manchester
June 2008

Rev	Date	Details	Prepared by	Reviewed by	Approved by
01	August 2007	DRAFT	**Michael Timmins** Principal Flood Risk Specialist **Peter Morgan** Planner	**Jon Robinson** Associate **Alan Houghton** Head of Planning North West	**David Dales** Director
02	December 2007	DRAFT FINAL	**Michael Timmins** Principal Flood Risk Specialist **Peter Morgan** Planner	**Jon Robinson** Associate **Alan Houghton** Head of Planning North West	**David Dales** Director
03	June 2008	FINAL	**Michael Timmins** Principal Flood Risk Specialist **Anita Longworth** Principal Planner	**Jon Robinson** Associate **Alan Houghton** Head of Planning North West	**David Dales** Director

Scott Wilson
St James's Buildings,
Oxford Street,
Manchester,
M1 6EF,
United Kingdom

Tel: +44 (0)161 236 8655
Fax: +44 (0)161 228 2581

Table of Contents

1. Bolton Metropolitan Borough Council

1.1. Bolton Development and Planning Context

The Metropolitan Borough of Bolton is situated in the northwest part of the Greater Manchester conurbation. Bolton is about 20 km from the centre of Manchester City. The District covers an area of about 13,980 ha and has a varied landscape consisting of rugged West Pennine Moors to the north and east and the urban, industrial locations that comprise the main commercial core of Bolton, Westhoughton, Horwich, Farnworth, Little Lever and Kearsley.

Bolton is one of more self contained of the Greater Manchester Authorities and, according to the Annual Population Survey (March 2006), 75.4% of the working age population were economically active, some 121,500 people in the District. A strong performing economy and a flexible labour market in Great Britain have resulted in low unemployment rates. Bolton has been mirroring this trend and has maintained a strong performance, although North West and UK averages have performed better. A map presenting planning information for Bolton is included at the end of this section (Figure Bolton Overview/02).

1.1.1. Strategic and Regional Position

Bolton MBC is one of the Authorities that make up the northern part of the Manchester City Region in the draft RSS and therefore relates to the other Authorities in this grouping, particularly neighbouring Bury and Wigan. Bolton also forms a key gateway into and out of Greater Manchester with the M61 going through the District between Manchester and Central Lancashire. As such, Bolton also relates closely with the Lancashire Authorities, particularly neighbouring Blackburn and Chorley. Within the draft RSS, Bolton is not highlighted as a location for any key regionally strategic sites.

1.1.2. Local Development Framework

Timetable

Bolton's Local Development Scheme (LDS) sets out the timetable for the development of their Local Development Framework (LDF). The Core Spatial Strategy is currently at the Issues & Options stage but is expected to shortly move forward to the public participation on Preferred Options stage. Preparation of the Site Allocations DPD has begun but is at an early stage. All the Greater Manchester Authorities are preparing a Joint Waste DPD, which will be at the 2nd stage Issues & Options Paper in January 2008. The Bolton LDS sets out seven Supplementary Planning Documents (SPDs), three of which will be adopted by the end of 2007 and a further three by the end of 2008. The Bolton UDP (2005) has been saved as statutory planning policy for Bolton until the LDF is complete.

The Issues and Options Report of the Core Strategy sets out a series of options for the spatial distribution of new development in the District, which will be central in influencing where land for development is likely to come forward. These are:

Option 1 – Dispersed Urban Development – focuses development across the existing built-up areas in the District;

Option 2 – Concentrated Urban Development – focuses development within specific regeneration areas and town / district centres along key transport corridors within the District;

Option 3 – Dispersed urban development combined with some peripheral development – similar to Option 1 but includes development of some open land on the periphery of the built-up area; and

Option 4 – Dispersed urban development combined with some peripheral development including the Green Belt Land – similar to Option 3 but includes some development on green belt land.

Regeneration Activity

Bolton, as an Authority, have received in excess of £34 million in Neighbourhood Renewal Fund allocations since 2001, funding which is to be used to narrow the gap between deprived areas / communities and the rest of society. Locally, the Issues and Options Report of the Core Strategy identifies regeneration as one of the main issues affecting the District and this will likely be reflected in the Preferred Options Report but the existing policy framework (the UDP) has no regeneration-specific policies and does not set out any specific locations for regeneration activity.

Housing Land

Regional Planning Guidance for the North West (RPG 13) sets a net annual housing requirement for Bolton of 450 dwellings between 2003 and 2016, with a total requirement of 2,250. However, the draft RSS proposed a revised net figure of 9,200 or 511 units per annum between 2003 and 2021. The RSS Panel considers that the figure should be 10,400 or 578 annually. Bolton would prefer an annual target of 670 dwellings net clearance.

Table 1-1 Regional Spatial Strategy Targets: 2003 – 2021

	Draft RSS Target	Panel Review Recommended Target	Bolton Preferred Target
Overall Housing Increase 2003-21	9,200	10,400	12,060
Mean Annual Increase	511	578	670
Indicative Previously Developed Land	80%	80%	80%

The Housing Supply Trajectories can be drawn from the Chart below (Figure 10-1).

Figure 10-1 (AMR 2006, p.43), which shows completions by financial year to 2005/06 and projected completions until the year 2015/16 and then overlays the proposed annual housing requirement from RPG 13 + 20 clearance units (470 units), the draft RSS target + 20 clearance units (531 units) and Bolton's preferred target including clearance units (670 units). As can be seen, in general, recent years have seen an under-supply of housing in comparison to all three targets until 2005/6 when it rose to a level above all three targets. This over-supply in comparison to the targets is expected to continue until 2008/09 when the projected figures drop to meet the Bolton preferred target until 2015/16.

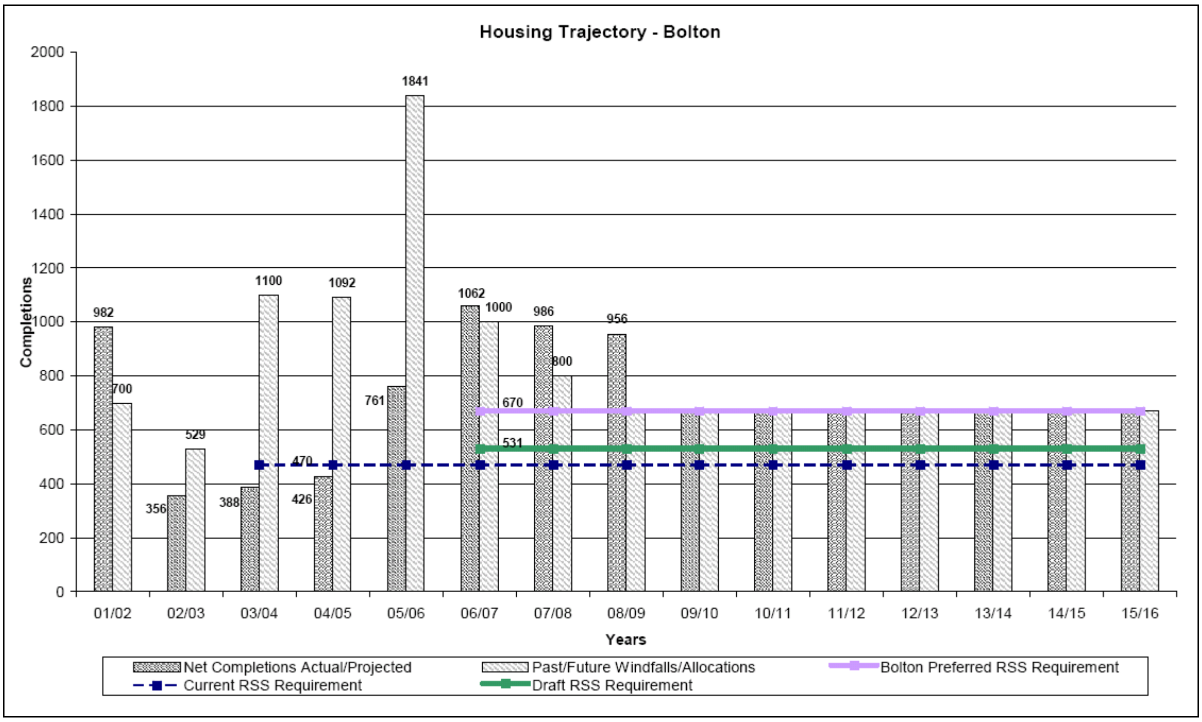


Figure 10-1: Housing Trajectory for Bolton

The housing requirement will be met through the development of sites that currently have planning permission and windfall sites. Bolton's Housing Land Availability Study in March 2006 showed that there was a total housing land supply with planning permission for 4,930 dwellings but further sites will need identifying later in the RSS period. In the future, the Allocations Development Plan Document, currently in the early stages of preparation, will identify further sites.

Employment Land

The council's Annual Employment Land Resource (AELR) monitors employment land. Tables 1-2 and 1-3 outline the amount of available land within the Bolton AELR at the end of the 2007 monitoring period, compared to the position at the end of March 2006.

Table 1-2: Employment Land available

	Area in Hectares	Number of Sites
Land available at end of March 2006	79.49	26
Sites with size adjustments (18E & 22E)	*-1.7i*	
Sites completed	*-6.99*	*-4*
Partial sites completed	*-0.26*	*0*
Sites under construction	*-2.87*	*-1*
Sites removed from AELR as they have no scope for development and with current existing uses on them	*-5.29*	*-6*
Land available at end of March 2007	62.37	15

Source: *AELR 2007, p.12*

This land resource can be split down by timescale for likely availability as follows:

Table 1-3: Employment Land by Category

Timescale	Category of land	No. of sites	Hectares	% of land
Available now or within 3 years	Available	9	6.29	10.08
4-7 years	Medium term	4	51.61	82.75
8-15 years	Long term	2	4.47	7.17
	TOTAL	15	62.37	100

Source: *AELR 2007, p.13*

As can be seen, the majority of proposed employment land in Bolton will be available in 4-7 years. Given that completion rates for employment land over the last five years have averaged out at 11.3 ha per annum, this means that there may be a shortfall of employment land being brought forward in the short-term and in the long-term unless further employment land is identified. This shortage would be exacerbated if Option EL B of the Core Strategy Issues and Options Report is chosen as the way forward for employment development, as this calls for an increased rate of development for employment land compared to the last five years.

Transport Infrastructure

Bolton is well served by public transport and in terms of strategic road corridors. The M60/62, M61 and the M66 (just the other side of Bury) provide good access to the nation's motorway network for the District, particularly to the rest of the Northwest and to West Yorkshire. The A666 provides a north-south strategic road corridor through the District, linking Bolton directly to Blackburn to the north and the A58 / A676 provides an east-west strategic road corridor through the District, linking Bolton westwards to Wigan and Liverpool and eastwards to Bury and Rochdale.

Bolton train station has regular trains to Manchester, Salford, Wigan and key Lancashire towns and, via the likes of Manchester Piccadilly station, the rest of the UK. There are also regular bus services to Manchester City Centre, passing through Salford.

Within the District, Bolton's public transport is generally very good, with virtually all parts of the District being within 30 minutes on public transport to a GP / health centre, employment areas, primary and secondary schools and town or district retail centres. Access via public transport to a hospital is not so efficient, predominantly due to the location of Bolton Royal Hospital in the southern part of the District (AMR, 2006, p.44).

1.2. Bolton Flood Risk Summary

1.2.1. Hydrological background: catchment and watercourse network

The District of Bolton lies within the Greater Manchester SFRA area. The District is situated mostly in the middle and upper catchments of the Rivers Croal, Irwell, Douglas and Glaze Brook. All of these watercourses carry with them an inherent potential flood risk. The middle reaches have flatter and lower topography than the upper catchment and flooding can be spread over a larger area than in the steeper and more confined floodplains of the upper catchment. The main urban areas at greatest risk from flooding in the District are Bolton, Horwich, with parts of Westhoughton and Farnworth also at risk. The draft River Douglas CFMP, the draft Mersey Estuary CFMP and the River Irwell CFMP cover the District and are used by the EA to inform a flood risk management strategy within a catchment. All three CFMPs also provide flood risk information of particular relevance to Bolton that can be used to increase the quality and accuracy of flood risk information presented in the SFRA. A map presenting flood risk information for Bolton is included at the end of this section (Figure Bolton Overview/01). Table 1-4 shows the main watercourses and main urban areas at risk of flooding from each.

Table 1-4: Watercourses and Urban Areas at Risk in Bolton MBC

Main Watercourses	Urban area at risk
Croal	Bolton, Farnworth,
Irwell	Bolton
Pearl Brook, Douglas	Horwich
Rivington Reservoirs, Douglas	Horwich
Pennington/Hall Lee Brook, Glaze	Westhoughton

1.2.2. Historical Flooding

A review of the information supplied by the council, the EA, CFMP's, and through searching online historical records[1], has revealed that Bolton has experienced a number of flood events throughout the last century. Historically the District has experienced river flooding predominantly from the Croal and surface water and sewer flooding from localised intense rainfall events. Comments received from the EA reveal flood events were recorded on Bessy Brook in 2002 and 2007, however searches revealed no further details on these events. The historic records of flooding show that the District is vulnerable to both periods of prolonged rainfall in the autumn and winter months mainly leading to fluvial flooding, and local flash flooding primarily of surface water caused by intense summer downpours. Table 1-5 shows a number of significant historical flood events.

1. British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe/[1]

Table 1-5: Significant Historic Flood Events in Bolton MBC

Date	Location	Source of Flooding	Impact	Source of Information
August 1878	Little Lever	Canal breached at Nob End	Localised flooding	Bolton Evening News
August 1895	Darcy Lever, Blackshaw Brook/Croal	Fluvial	Localised flooding	BHS Database
July 1936	Little Lever	Canal breached at Nob End	Flooded paper mill	Bolton Evening News
July 1964	Bolton, Croal	Fluvial	Localised flooding	BHS Database
October 1992	Horwich	Surface Water flooding	Localised flooding	Bolton Evening News

1.2.3. CFMP Assessment of Flood Risk

The District is covered by the draft River Douglas CFMP, the draft Mersey Estuary CFMP and the River Irwell CFMP. Draft policies are subject to change and the SFRA must be adapted accordingly. CFMP's have split overall flood risk in the District into the eight spatial areas, each assigned with a degree of risk (high, medium and low) as displayed in displayed in Table 1-6. The CFMPs have also recommended a preferred policy option number for each unit. The generic policy options are shown in Table 1-7.

Table 1-6: Policy units and preferred policies for Bolton

Policy Unit	Policy Option	CFMP	Risk
10: Swinton and Eccles	5	River Irwell	Medium/High
4. Kearsley to Kersal (Irwell)	6	River Irwell	Low
15: Bolton (Croal)	5/4	River Irwell	Low
16:Rural Croal	6	River Irwell	Low
1: Rivington Reservoir and Catchment	1	River Douglas	Low
2: Fluvial River Douglas and its tributaries	4	River Douglas	Medium
5: Built up areas	4	River Douglas	Medium
1: Glaze	2	Mersey Estuary	Low

Table 1-7: Generic CFMP Policy

Policy 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)

1.2.4. Current and Future Flood Risk in Bolton MBC

Identification of flood sources

Flooding from Rivers

The historic flood event search, the EA, the City Council, and the CFMP all suggest that the main flood risk within the District is flooding from rivers, though the overall risk is less relative to other AGMA authorities. Flood risk is highest in the steeper areas in the upper catchment sections such as Horwich. The upper reaches are susceptible to short-term intense rainfall events such as thunderstorms where large volumes of water are confined to relatively narrow river valleys. Middle and lower reaches of rivers in the catchment tend to be at risk from fluvial flooding attributed to prolonged rainfall activity as the naturally flatter topography drains a larger catchment area. Areas surrounding confluences of tributaries and main channels such as Darcey Lever at the confluence of Bradshaw Brook and River Tonge and at the Tonge and Croal confluence, have an increased flood risk, particularly if flood peaks on both watercourses coincide or flow exceeds culvert capacity. The main flood risk areas in the District are Bolton and Horwich. Flooding due to flow restrictions, which can be attributed to sedimentation and blockage of structures and weirs, is a risk. This type of flooding is primarily found upstream of structures when water backs up behind the blockage and ultimately overtops the channel. There are numerous culverted sections of the Croal and minor watercourses throughout the District which are at risk of this type of flooding.

Whilst fluvial flooding poses a significant risk to the District, 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.

Flooding from the Land

During periods of prolonged rainfall events and sudden intense downpours, overland flow from adjacent 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. 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.

Flooding from Sewers

Sewer flooding is another flood risk throughout the District, 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 the watercourse. The water then backs up and will again start to discharge. Sewer flooding was identified using historical records from United Utilities DG5 database (June 2007) detailing the total number of flood events that affected both internal and external property. Sewer and surface water flooding is known to have occurred in Bolton and Horwich.

It should be noted that much of the sewer network is thought to date 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 the WRC "Sewers for Adoption"[2]. 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 this design standard is not achieved. It is therefore likely that much 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.

[2] Sewers for Adoption, Wrc Publications 2006

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) (Figure 1-2) 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 that is also covered by the Data Protection Act (1998). According to the data, Bolton MBC has one of the lowest internal recorded sewer flooding incidents (16) in the AGMA sub-region. However, DG5 data is a "snapshot" in time and may therefore have missed a significant rainfall event. As a result, a detailed analysis of the scale and consequences of sewer flooding has not been possible at this stage of the SFRA.

However, during the course of this study, 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 and AGMA have agreed to share data on drainage and development areas initially for Bury and Salford. This will allow both UU and AGMA to determine the usefulness of the data and to agree how it can be spatially represented on a sub-regional and strategic basis for the whole of the AGMA area. It is anticipated that both UU and AGMA will have agreed the scale and format of the data in time for Level 2 assessments.

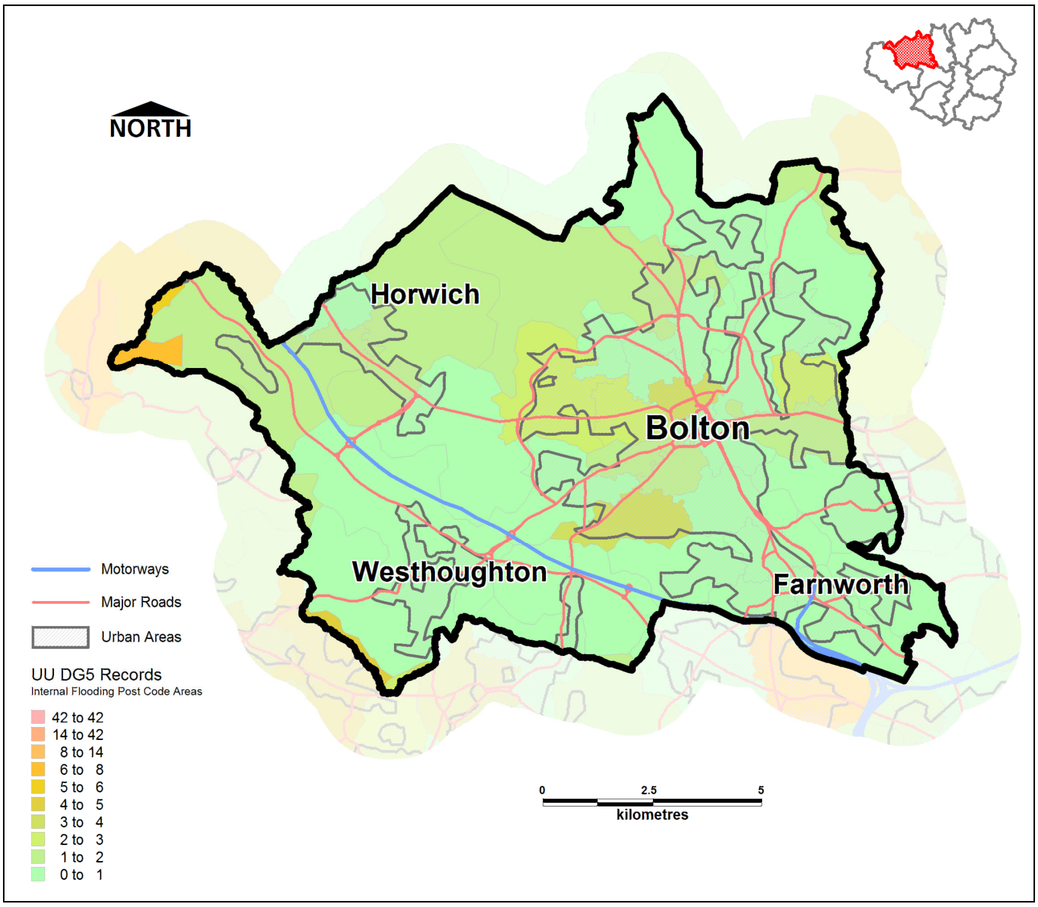


Figure 1-2: Bolton UU DG5 data (June 2007) showing instances of Internal Flooding by five-digit postcode area.

Flooding from Reservoirs, Canals and Other Artificial Sources

There are a number of reservoirs upstream of the District. Reservoirs have an attenuating effect on flood flows and can be used to control flows though it should be noted they are not operated for flood risk management in the area. Reservoirs do however have a flood risk associated with them in terms of dam/reservoir wall failure and emergency releases into the catchment. The likelihood of this occurring is minimal but impacts are potentially extremely high due to the limited warning time available and the potential high velocity and high volume flows. The River Douglas CFMP states that localised flooding has occurred in the Douglas immediately downstream of the Rivington reservoirs following emergency releases, but such incidents have been keep to a minimum and only occur following consultation between key management authorities.

The Bolton and Bury Canal runs through the District. 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 remains where water levels could overtop or breach embanked sections. Searches revealed that in 1936 there was a major breach of the canal which led to boats being swept from the canal summit down into the river Irwell below as the canal waters quickly drained. The canal is currently undergoing a restoration programme following its closure after the breach[3].

Flooding from Groundwater

Searches revealed no reported incidents of groundwater flooding in the District. British Geological Survey (BGS) Maps show the area to be underlain primarily by mudstone, siltstone and sandstone. As a result, the EAs groundwater vulnerability maps show that much of the District is classified as minor aquifer with higher permeability.

The impacts of increased development in these areas must therefore 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.

Fluvial Flood Zones

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 and each outline used to create the SFRA flood zones assumes that no defences exist. There are no areas of tidal flood risk within the AGMA sub-region.

[3] http://www.penninewaterways.co.uk/mbb/mbbc30.htm

However, there are areas where little or no accurate flood outlines exist and therefore, to ensure a continuous coverage across a flood zone, less accurate, broad-scale modelled (the EA J-FLOW Flood Zones) outlines were used instead. This hybrid approach provides a conservative flood zone and highlights potential uncertainties that can either be resolved in more detail at more detailed Level 2 stage, or by developers as part of site-specific FRAs. The SFRA has identified the following flood zones in accordance with PPS25:

Flood Zone 1: Low Probability of Flooding
Land having a less than 1 in 1000 annual probability of river 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%) in any year. Detailed modelling to determine the 1000yr flood outline has recently been completed by the EA on the River Irwell[4]. However, for the rest of Bolton MBC, no detailed modelled outlines exist for Flood Zone 2 and therefore, the EA broad-scale Flood Zone 2 maps were used.

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

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. Where possible, 1:20 or 1:25 year detailed modelled outlines were used to define the functional floodplain. Some defended areas may include flood storage basins which are by their very nature functional floodplain. 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 in the data and potential tasks for the more detailed Level 2 assessments. 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.

Using the Flood Zone maps, the total area of Bolton at risk of fluvial flooding can be determined. Table 1-8 and Figure A-5 (Appendix A) show that there is not a significant proportion of the District at risk of flooding when compared to other AGMA councils. Approximately 3.75% of the District is at risk of fluvial flooding in Flood Zones 2 and 3.

[4] River Irwell Model Review and Update, Environment Agency, October 2007.

Table 1-8: Area of Fluvial Flood Risk to Bolton MBC

District Area (ha)	Urban Area (ha)	Fluvial Flood Zone	Area (ha)	% (of District or Urban Area)
13,934.90	4,493.06	FZ3b	165.27	1.19
		FZ3a	147.04	1.06
		FZ3 in Urban	312.31	2.24
		FZ3 + CC	98.04	0.70
		FZ2	209.36	1.50
		FZ2 in Urban	88.14	1.96

Note: Figures for FZ3a refer to the area outside of FZ3b, figures for FZ3+CC and FZ2 refer to the area outside of FZ3a.

Flood Zone Confidence

Flood Zone Confidence Maps are intended to be used by planners as a tool for identifying areas of high, medium or low confidence in the data that has been used to derive fluvial Flood Zones across the sub-region and also to determine where further work is required. The confidence assigned to a Flood Zone demonstrates the level of detail and the number of assumptions made when deriving the Flood Zone. The maps can be used to determine reaches of river where further, more detailed work is required to refine Flood Zones and therefore where resources should be directed.

Table 1-9 illustrates the confidence assigned to the Flood Zones present within Bolton MBC. A map showing confidence in the each of the Flood Zones is presented at the end of this section (Figure Bolton Overview/03).

Table 1-9: Fluvial Flood Risk Confidence for Bolton MBC

District	Fluvial Flood Zone	Watercourse	Settlement	Source	Date of Modelling Study	Confidence
Bolton	3b	All Other Watercourses	Horwich	EA Flood Zone Maps	NA (May 2008)	Low
		Cunningham Brook, Marsh Brook	NA	Middle Lower Mersey Model	2001 (May 2008)	High
		River Irwell	Kearsley	Irwell ABD (Draft)	2008 (May 2008)	Low
		River Croal	Bolton	Irwell Review Model	2007 (May 2008)	High
	3a	All Other Watercourses	Horwich	EA Flood Zone Maps	NA	Medium
		River Croal	Bolton	Irwell Review Model	2007	High
		Cunningham Brook, Marsh Brook	NA	Middle Lower Mersey Model	2001	High
		River Irwell	Kearsley	Irwell ABD (Draft)	2008	High
	3a + CC	River Croal	Bolton	Irwell Review Model	2007	High
		River Irwell	Kearsley	Irwell ABD (Draft) - Flood Zone 2	2008	Low
		All Other Watercourses	Horwich	EA Flood Zone Maps - Flood Zone 2	NA	Low
	2	All Other Watercourses	Horwich Bolton	EA Flood Zone Maps	NA	Medium
		River Irwell	Kearsley	Irwell ABD (Draft)	2008	High

Climate Change and Future Flood Risk

The CFMP's have 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 District. Defra/UKCIP (United Kingdom Climate Impacts Programme) 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. Results showed an average increase in flows of 25% across the Douglas and Glaze Brook catchments. Kearsley was particularly sensitive to urban and climate change scenarios with 50 new properties at risk of flooding.

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)[5] 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

[5] 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

impermeable areas. Potentially, this could lead to 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. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

The location of future urban developments and flood defences within a catchment can influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments. It may however be possible to mitigate against this 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.

To account for Climate Change at the sub-regional level, 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 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 Level 2 stage or Site-Specific FRAs.

Flood Risk Mitigation and Management

Flood Risk Management

Flood risk management assets may be hard formal structures designed for purpose such as flood walls, or they may be informal structures such as garden walls which were not designed specifically as defence structures, but are now performing that role. The National Flood and Coastal Defence Database (NFCDD) identifies any asset (including channels) that may have an impact on flood risk management and is constantly being updated and amended by the EA as a result of ongoing asset inspections. It should be noted that the database assigns a Standard of Protection (SoP) to flood defence assets and has a default value of 50 Years. Therefore the SoP values should be treated with caution and assessed (in conjunction with the EA) on a site-by-site basis during the more detailed Level 2 assessments. NFCDD data, along with CFMP's and council supplied information, have been used to identify the following major structures and flood defences assets in the District.

Reservoirs:	Rivington near Horwich - used for river regulation. Worthington-Arey-Adlington water supply reservoirs nr Adlington. Star reservoir, Horwich.
Canal:	Bolton and Bury Canal.

There are flood defences protecting several developments within Bolton town.

By interrogating NFCDD outputs, a series of informative statistics about flood risk assets can be obtained. For Bolton MBC, data from NFCDD shows that there are over 19km of culverted watercourses and 4.25km of man made raised flood defences, 4.17km of which have a SoP of between 21 and 50 years (Table 1-10).

Table 1-10: NFCDD data summarising lengths of flood defence asset in the Bolton MBC Area (km) by Standard of Protection (return period in years).

Asset Type	Length of FRM Asset (km) by Standard of Protection in years					
	Unclassified	0-20	21-50	51-75	76-100	Total
Culverted Channel	0.02	0.02	18.56	0.51	0.00	19.09
Maintained Channel		0.00	0.21	0.03	0.00	0.24
Natural Channel		0.26	41.08	4.57	0.03	45.95
Flood Defence Structure		0.00	100.95	0.38	2.05	103.38
Non-Flood Defence Structure	0.15	0.20	1.39	0.19	0.00	1.78
Raised Defence (Man-Made)		0.00	4.17	0.00	0.08	4.25
Total	**0.17**	**0.48**	**166.4**	**5.68**	**2.17**	**174.69**

Mitigation

There are many different types of flood risk mitigation actions ranging from small, single dwelling flood proofing measures to flood warning services to large multi-million pound flood defence schemes.

There are flood warning areas in the Farnworth and Little Lever area which have been an effective mitigation measure for many years. However, flood warnings tend to work most effectively during large events with long lead times so that sufficient advance notice is given to residents and businesses and are usually only applicable to fluvial flooding. In the case of intense, flashy rainfall events, where pluvial and sewer flooding may pose the most risk, flood warnings schemes rarely exist.

The River Irwell CFMP identifies a potential flood storage location in the District, just north of Bolton in the headwaters of the Eagley, Bradshaw and Astley Brook which could decrease damages in the Bolton and Kearsley areas by 3-5%.

Risk of Failure of Defences and Impacts

Behind defended areas there is a residual risk of 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 tend to be low lying, and the water level will have often built up to a higher level than ground levels of the defended area. The same risks can be associated with reservoir/dam failure, though the risk of such failures is considered to be minimal.

People and Property at risk of flooding

The EA carried out a strategic review of flood risk for the whole of the North West Region[6]. This looked at the EA Flood Zones and the number of properties at risk of flooding within each District in the North West. Table 1-11 shows the number of properties at risk of flooding in each flood zone and Table 1-12 shows the population by property type in each flood zone.

Table 1-11: Properties at risk of flooding (source: EA Flood Zone Ranking using EA Flood Zones)

FZ3	FZ2&3	FZ1	Total
947	1,450	120,911	122,361

Using census Output Area (OA) data (the smallest census geographical area), and updated mid-term 2005 population estimates for Bolton, the potential populations affected by flooding in the different flood zones are presented in Table 1-12. 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 a district, 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 a CO by the type of accommodation they live in. Again, assuming an even distribution across a CO, an indication as to the predominant types of properties at risk can be shown.

Table 1-12: Approximate number of people affected by fluvial flooding in Bolton

	Population at Risk (2005)	People living in House Bungalow	People living in Flat or Apartment	People living in Caravans or moveable Accommodation	People living in Shared Dwelling
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

1.3. Strategic Overview of Flood Risk in Bolton MBC

1.3.1. Consequences of Upstream and Downstream Development

Broad development upstream of Bolton on the River Croal and the within the Irwell, Douglas and Glaze catchments is defined within the RSS in terms of housing figures. As the District is located towards the upstream extent of the Douglas, Irwell, Croal and Glaze catchments, there is only one district upstream (Figure 1-3) that is connected to Bolton hydrologically and therefore has the potential to adversely affect the current flood risk in Bolton. The main potential adverse impacts that future development may have on downstream areas is twofold:

[6] 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)

Reduction in Floodplain: Unrestricted development in floodplains can reduce the natural flood storage capacity of a river and, consequently, convey more water downstream.

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.

Should RSS housing targets be met, for example, a total of 8,800 new homes will be built in districts upstream of Bolton. A further 148,540 homes are proposed in districts downstream of Bolton. These figures are for net new housing and so are additional to the current levels of development. Furthermore, many of the districts have a high target for development on previously developed land (PDL). As a result, if no measures are taken to control runoff from new development, there is the potential for an increase in flood risk to Bolton. In reality, however, the relative scale of development upstream is low and it is likely that much of the new development will be constructed to modern and sustainable standards incorporating, where possible, SuDS to limit runoff.

Downstream and adjacent to Bolton are Bury MBC, Salford CC, W. Lancashire, Manchester CC, Trafford MBC, Wigan MBC and Warrington MBC. Within the draft RSS, Bolton is not highlighted as a location for any key regionally strategic sites, however, development in Bolton has the potential to impact on the flood risk of downstream and adjacent districts. As identified by the CFMPs, Bolton contains areas to provide potential floodplain storage (for example, in the headwaters of Eagley, Astley and Bradshaw Brooks). However, to avoid reducing floodplain storage and potentially increasing flood risk downstream, development within and adjacent to these areas must be undertaken carefully so as not to adversely affect flood storage or flood flow routes. In addition, the incorporation of green open spaces and SuDS measures may help to reduce increased runoff.

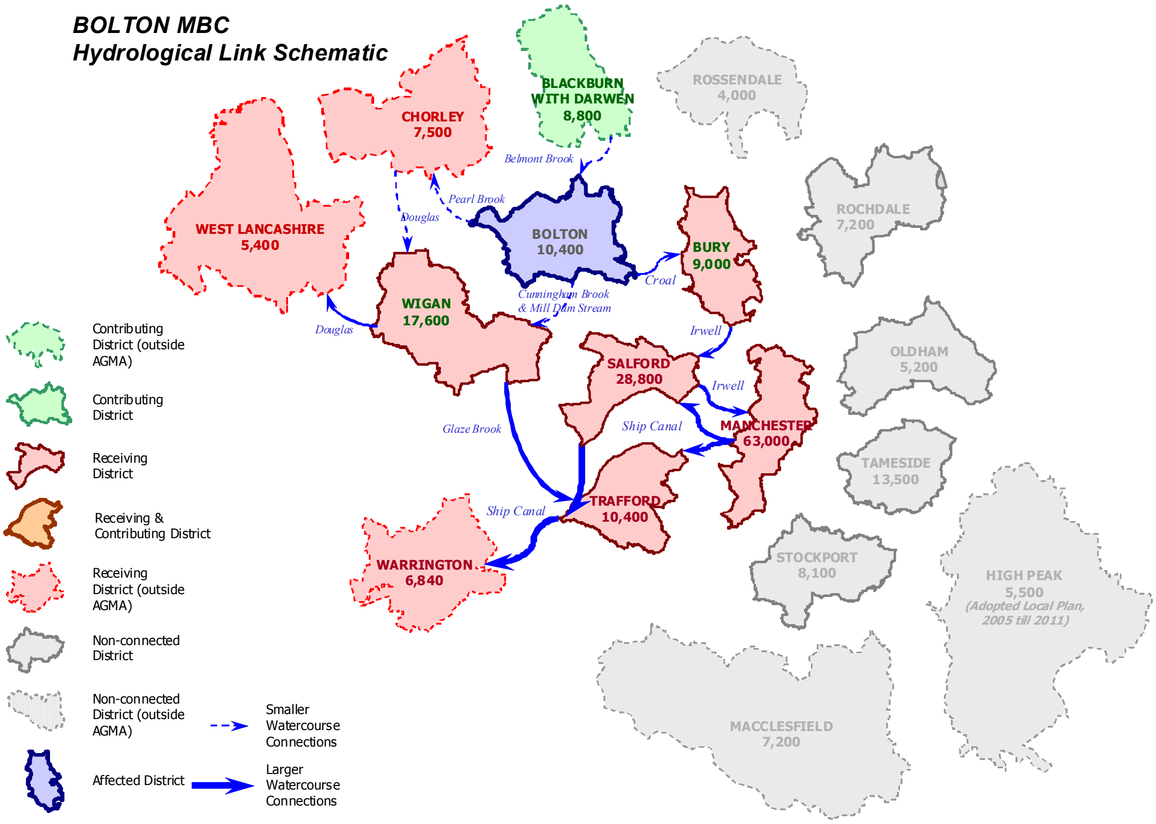


Figure 1-3: Hydrological Links to and from Bolton MBC

1.3.2. Potential Conflicts between broad development aspirations and the PPS25 Sequential Test

As highlighted above, the current flood risk to the district is primarily from fluvial sources, in particular the River Croal. In addition, there is, at present, an unquantified risk of flooding from the Bolton and Bury Canal.

Most of the proposed development areas, include some of the most populated areas in Bolton, i.e. the town centres and surrounds. Therefore, there is potential for an increase in the amount of impermeable area and the subsequent increases in runoff and the impacts on surface water and sewer flooding. Using UU data and the Urban Morphology Types (UMT) boundaries from the ASSCUE project the percentage of impermeable areas within the district can be identified and it is recommended that the risks associated with potential surface water (pluvial) and sewer flooding in these areas is examined in more detail at Level 2 stage.

As a result, potential conflicts exist between development and the PPS25 Sequential Test in these areas. In order to examine these in more detail, it will be necessary to create maps showing more detailed flood outlines taking into account functional floodplain and climate change (as per PPS25 requirements) and displaying the risk associated with the Bolton and Bury Canal during a more detailed Level 2 assessment.

1.3.3. Impacts on and from other strategic spatial considerations

Other spatial considerations that Bolton MBC should take account of with regards to flood risk include the Greater Manchester Green Infrastructure Scoping Study, 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. It is important that such 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.

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.

Waste and hazardous substances can also be affected by flooding and potentially introduce harmful and polluting substances into flood waters for transport and distribution elsewhere. The Greater Manchester Waste DPD is currently being undertaken and identifies current and future areas for waste management, storage and transfer. Using this in conjunction with the SFRA may help to reduce the risk of flooding to waste sites.

1.3.4. Strategic Effects of Defence failure

Impacts of defence failure include fast flowing, deep water which has the potential to cause major damage and loss of life. However, relative to other councils in the AGMA sub-region, there are few defended areas where numerous properties and lives are protected to a high standard. As a result, it is not thought that the impacts of defence failure in Bolton will adversely impact on areas and councils downstream.

1.3.5. Identifiable strategic mitigation options

Strategic options for mitigation include the upstream flood storage schemes. The River Irwell CFMP identifies a potential flood storage location in the District, just north of Bolton in the headwaters of the Eagley, Bradshaw and Astley Brook which could decrease damages in the Bolton and Kearsley areas by 3-5%. However, due to the limited reduction in damages, it is not thought that the scheme will be feasible at this time.

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 catchment is reduced. Furthermore, and working closely with the outputs from the current sub-regional Green Infrastructure study, careful land use planning and the gradual reinstatement of green open spaces together with wetlands and woodlands throughout the catchment may help to further reduce runoff.

Bolton_Overview/01

Bolton_Overview/02

Bolton_Overview/03

2. Bury Metropolitan Borough Council

2.1. Bury Development and Planning Context

The Metropolitan Borough of Bury is situated due north of the Greater Manchester conurbation approximately 12 km from Manchester city centre and covers an area of approximately 9,900 ha. It is made up of the towns of Ramsbottom, Tottington, Bury, Radcliffe, Whitefield and Prestwich. The District is mixed in character with the northern regions being characterised by the rural landscapes of the West Pennine moors, while the southern regions are characterised by an industrial and more densely urban landscape as it approaches Manchester.

Bury has a population of about 183,500, which is set to increase to 188,300 by 2015 (AMR 2006, p.12). There were an estimated 76,000 households within the District in 2003 and this is anticipated to rise to 91,000 households by 2026 (DCLG 2003-based Household Projections, AMR 2006, p.14). A map presenting planning information for Bury is included at the end of this section (Figure Bury Overview/02).

2.1.1. Strategic and Regional Position

Bury MBC is one of the Authorities that make up the northern part of the Manchester City Region in the draft RSS and therefore relates to the other Authorities in this grouping, particularly neighbouring Rochdale and Bolton. Bury also forms a key gateway into and out of Greater Manchester with the M66 going through the District between Manchester and East Lancashire. As such, Bury also relates closely with the East Lancashire Authorities, particularly neighbouring Blackburn and Rossendale. Within the draft RSS, Bury is not highlighted as a location for any key regionally strategic sites.

2.1.2. Local Development Framework

Timetable

Bury's Local Development Scheme (LDS) sets out the timetable for the development of their Local Development Framework (LDF). The Core Spatial Strategy is currently at the Preferred Options Stage (May 2008) and the Site Allocations DPD is at an early stage, undertaking the site suggestion exercise. All the Greater Manchester Authorities are preparing a Joint Waste DPD, which will be at the 2nd stage Issues & Options Paper in January 2008. The Bury LDS sets out 16 Supplementary Planning Documents (SPDs), 8 of which have been adopted, while a further 5 are Supplementary Planning Guidance Notes carried forward as SPDs. The remaining 3 are currently being developed or updated. The entire Bury UDP has been saved as statutory planning policy for Bury until the LDF is complete, with the exception of policy OL7/1 (East Lancashire Paper Mill Water Catchment Area).

Regeneration Activity

Bury, or locations within Bury, are not part of any national regeneration programmes. However, locally, East Bury (the area directly east of Bury Town Centre) and the town of Radcliffe are Regeneration Areas and, together with Bury Town Centre and its immediate surrounds, is the focus of the District's regeneration activity.

Housing Land

Regional Planning Guidance for the North West (RPG 13) indicated an annual requirement of 230 dwellings to be constructed in the District. The housing trajectory indicates that the District had exceeded this requirement for the six years preceding the publication of the draft Regional Spatial Strategy, which indicated an annual requirement of 600 dwellings. The Panel Review of the draft Regional Spatial Strategy recommends that this figure is reduced to 500 dwellings.

Table 2-1 Regional Spatial Strategy Targets: 2003 – 2021

	Draft RSS Target	**Panel Review Recommended Target**
Overall Housing Increase 2003-21	10,800	9,000
Mean Annual Increase	600	500
Indicative Previously Developed Land	80%	80%

The Housing Supply Trajectories can be drawn from the Chart below (Figure 2-1, AMR 2006, p.15) which shows net completions by financial year to 2005/06 and projected net completions until the year 2020/21 and then overlays the proposed annual housing requirement from the draft RSS (600 units). As can be seen, in general, recent years have seen an over-supply of housing in comparison to the target and this is expected to continue until 2014. When the proposed target is managed in light of this, the target gradually reduces year-on-year until 2015 when the projected net completions begin to fall below the 600 target and the managed target, causing the managed target to rise again.

The Council's Supplementary Planning Document, "Managing the Supply of Housing Land in Bury", is intended to manage the release of housing land and ensure a 10-year supply. Currently there is a 17.41-year land supply (AMR 2006, p.16) so the SPD places restrictions on any further release of land for housing. However, as the chart shows, beyond 2015 supply is expected to begin to decrease and this is an issue that Bury will need to address.

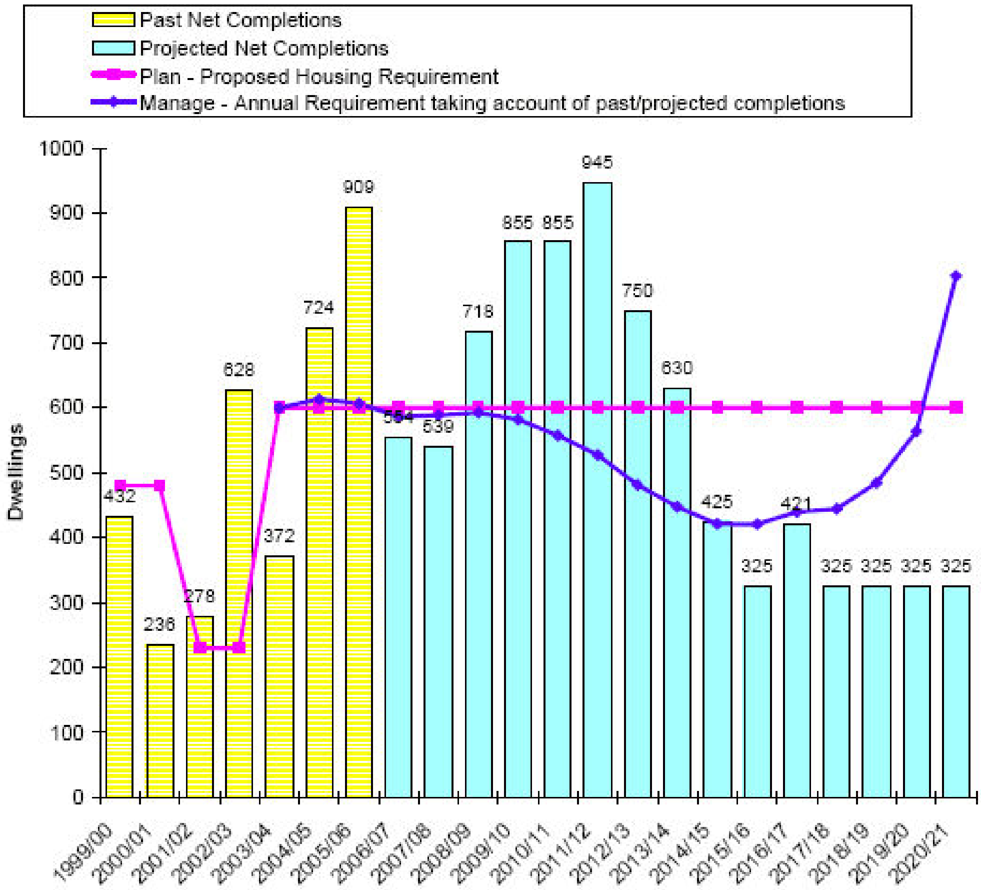


Figure 2-1: Housing Requirement and Completions for Bury

Table 2-2 below (taken from the Core Strategy Second Stage Issues & Options Report, July 2007, p.43) sets out the net number of housing completions since 2003, the number of units with planning permission and the potential number of units that could be accommodated on sites identified in the Urban Potential Study (UPS). This identifies the total number of units currently likely to come forward in the RSS period, and therefore a figure for "Years Supply" based on the Panel Review Recommended Target (a figure that has decreased from that identified in the AMR, in April 2006).

Table 2-2: Housing Completions and Supply

Source of Supply	Number of Units	Years Supply
Net Completions since 2003	2,350	4.70
Extant Planning Permissions	2,266	4.53
UPS sites (Incl remaining allocations)	3,000	6.00
Total	**7,616**	**15.23**

Based on these figures, the gap between anticipated supply from 2003 and the RSS target supply for 2003-2021 can be identified. Based on the Draft RSS Target, the gap would be approximately 3,200 units but based on the Panel Review Recommended Target, the gap would be approximately 1,400 units. This therefore sets the broad scale of land that will be required for housing development up to 2021.

The Core Strategy Second Stage Issues & Options Report sets out broad indications of where housing development should be focused, which are based on the sites from the UPS that are anticipated to come forward in the next ten to fifteen years.

Employment Land

The Council's current employment land projections involve a total of 90 ha of land, which may accommodate in excess of 11,000 jobs. 61 ha (nearly 8,500 jobs) of this is in locally strategic employment sites. The broad distribution of these locally strategic sites, which are:

- Bury Ground (Chamber Hall),
- Townside,
- Dumers Lane,
- Pilsworth.

These strategic sites reinforce the current spatial distribution of employment areas and build upon this foundation. These locally strategic sites are all in the central area of Bury, in and around Bury Town Centre and Radcliffe.

It is worth noting that nearly half of the District's working population commute out of the District to their place of work, in particular to Manchester. This is higher than any other Greater Manchester Authority. According to the Annual monitoring Report (2005-2006) there is a greater reliance on the declining manufacturing sector than desirable and many existing employment sites involve older industrial buildings that are unsuitable for modern businesses and so there is significant pressure on these sites and a need to redevelop some of them.

Transport Infrastructure

Bury is well-served by public transport and in terms of strategic road corridors. The M66 and the A56 provide north-south strategic road corridors through the District, south into Manchester and north into East Lancashire, while the A58 provides an east-west strategic road corridor, linking Bury westwards to Bolton and beyond and eastwards to Rochdale and beyond. The M60 / M62 also passes through the south of the District (with connects to the M66 and A56), creating easy connections for Bury to the rest of Greater Manchester, to the rest of the northwest, to West Yorkshire and to the M6 (and so Birmingham and London).

In terms of public transport, Bury has the Metrolink line to Manchester City Centre and connections from there to the rest of Greater Manchester via public transport and to major towns and cities across the UK via the rail network. Locally, Bury's public transport is very good, with virtually all parts of the District (except the most rural northwest corner) being within 30 minutes on public transport to a GP / health centre, employment areas, primary and secondary schools and town or district retail centres. Access via public transport to a hospital is not so efficient, predominantly due to the location of Fairfield Hospital in the eastern part of the District.

Despite this good provision of public transport The Core Strategy Second Stage Issues & Options Report identifies three issues relating to "improving transport and connectivity":

- A significant amount of the District's residents travel to work by private motor vehicle – particularly in the north and west of the District
- Use of public transport throughout the District is low – particularly in the north of the District
- The "school run" – the effect of this on congestion, pollution, road safety, residential amenity and access around schools is an increasingly significant issue

Therefore, there is a need to improve public transport infrastructure to improve connectivity to services and facilities and a need to locate new development within locations that are accessible by public transport and sustainable modes of transport.

2.2. Bury Flood Risk Summary

2.2.1. Hydrological background: catchment and watercourse network

Bury MBC is situated in the middle and upper catchment of the River Irwell. Other watercourses within the District include the River Roch, and Holcombe, Kirklees, Whittle, Hollings and Parr Brooks. All of these watercourses carry with them an inherent potential flood risk. The middle reaches have flatter and lower topography than the upper catchment and flooding can be spread over a larger area than in the steeper and more confined floodplains of the upper catchment. The main urban areas at greatest risk from flooding in the District are Bury, Radcliffe, Whitefield, and Ramsbottom. The River Irwell CFMP covers the District and provides a catchment wide assessment of flood risk and is used by the EA to inform flood risk management strategy within the catchment. The CFMP also provides flood risk information of particular relevance to Bury that can be used to increase the quality and accuracy of flood risk information presented in the SFRA. A map presenting flood risk information for Bury is included at the end of this section (Figure Bury Overview/01). Table 2-3 shows the main watercourses and urban areas at risk of flooding from each.

Table 2-3: Watercourse and Urban Area at Risk

Main Watercourses	Urban area at risk
Irwell	Bury, Radcliffe, Whitefield, Ramsbottom
Roch	Lily Hill, Whitefield

2.2.2. Historical Flooding

A review of the information supplied by the council, the EA, CFMP's, and through searching online historical records[7,] has revealed that Bury has experienced a number of flood events throughout the last century. Historically the District has experienced river flooding predominantly from the Irwell and surface water and sewer flooding from localised intense rainfall events. The historic records of flooding show that the District is vulnerable to both periods of prolonged rainfall in the autumn and winter months mainly leading to fluvial flooding, and local flash flooding primarily of surface water caused by intense summer downpours. Table 2-4 shows a number of significant historical flood events.

[7]British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe

Table 2-4: Significant Historic Flood Events in Bury MBC

Date	Location	Source of flooding	Impact	Information Source
November 1923	Bury	Fluvial flooding	Flooded homes in Bury	BHS Database
June 1959	Whitefield	Surface Water	Localised flooding	BHS Database
August 2004	Ramsbottom	Surface Water	Homes and a pub flooded	Comments from EA
July 2006	Ainsworth, Bury	Surface Water	Basements and gardens flooded	Bury Times
July 2006	Bury	Sewer flooding	Gardens flooded	Bury Times
January 2007	Bury	Surface water flooding	Gardens flooded	Bury Times
July 2007	Summerseat	Surface Water	Roads and gardens flooded	Bury Times

2.2.3. CFMP Assessment of Flood Risk

The District is covered by the River Irwell CFMP which has split the District into eight spatial areas, each assigned with a degree of risk (high, medium and low) as displayed in Table 2-5. The CFMP has also recommended a preferred policy option number for each unit. The generic policy options are shown in Table 2-6.

Table 2-5: Policy units and preferred policies for Bury MBC

Policy Unit	Policy Option	CFMP	Risk
4. Kearsley to Kersal (Irwell)	6	River Irwell	Low
5. Radcliffe Flood risk area (Irwell)	5	River Irwell	Medium/High
6. Bury (Irwell)	4	River Irwell	Low
7: Ramsbottom (Irwell)	4	River Irwell	Medium
8. Rossendale valley (Irwell)	5	River Irwell	Medium
9. Rural Rossendale (Irwell)	6	River Irwell	Low
16:Rural Croal	6	River Irwell	Low
17:Heywood and Whitefield (Roch)	3	River Irwell	Medium/High

Table 2-6: Generic CFMP Policy

Policy 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)

2.2.4. Current and Future Flood Risk in Bury MBC

Identification of Flood sources

Flooding from Rivers

The EA, Bury MBC and the CFMP all suggest that the main flood risk within the District is flooding from rivers and the main areas at risk are Bury, Ramsbottom, Whitefield and Radcliffe. Flood risk is highest in the steeper areas in the catchment such as Ramsbottom. The upper reaches are susceptible to short-term intense rainfall events such as thunderstorm activity where large volumes of water are confined to relatively narrow river valleys. Middle and lower reaches of rivers in the catchment tend to be at risk from fluvial flooding attributed to prolonged rainfall activity as the naturally flatter topography drains a larger catchment area. Areas surrounding confluences of tributaries and main channels, such as to the south of Bury/north of Whitefield at the confluence of the Roch and Irwell, have an increased flood risk, particularly if flood peaks on both watercourses coincide or flow exceeds culvert capacity. Radcliffe has been identified in the CFMP[8] as being at risk of flooding attributed to sedimentation.

Flooding due to flow restrictions that can be attributed to sedimentation, blockage or collapse of structures and weirs is also a risk. This type of flooding is primarily found upstream of structures when water backs up behind the blockage and ultimately overtops the channel. There are numerous culverted sections of the Irwell and minor watercourses throughout the District which are at risk of this type of flooding

Whilst fluvial flooding poses a significant risk to the District, 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.

Flooding from the Land

During periods of prolonged rainfall events and sudden intense downpours, overland flow from adjacent 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. Evidence exists of surface water flooding throughout the District (Table 2-4).

Flooding from Sewers

Sewer flooding is another flood risk throughout the District, 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 the watercourse. The water then backs up and will again start to discharge. Sewer flooding was identified using historical records from United Utilities DG5 database (June 2007) detailing the total number of flood events that affected both internal and external property.

It should be noted that much of the sewer network is thought to date 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 the WRC "Sewers for Adoption"[9]. 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 this design standard is not achieved. It is therefore likely that much 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.

[8] River Irwell CFMP, December 2006
[9] Sewers for Adoption, Wrc Publications 2006

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) (Figure 2-2) 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 that is also covered by the Data Protection Act (1998). According to the data, Bury MBC has one of the lowest (19) recorded sewer flooding incidents in the AGMA sub-region. However, DG5 data is a “snapshot” in time and may therefore have missed a significant rainfall event. As a result, a detailed analysis of the scale and consequences of sewer flooding has not been possible at this stage of the SFRA.

However, during the course of this study, 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 and AGMA have agreed to share data on drainage and development areas initially for Bury and Salford. This will allow both UU and AGMA to determine the usefulness of the data and to agree how it can be spatially represented on a sub-regional and strategic basis for the whole of the AGMA area. It is anticipated that both UU and AGMA will have agreed the scale and format of the data in time for more detailed Level 2 assessments.

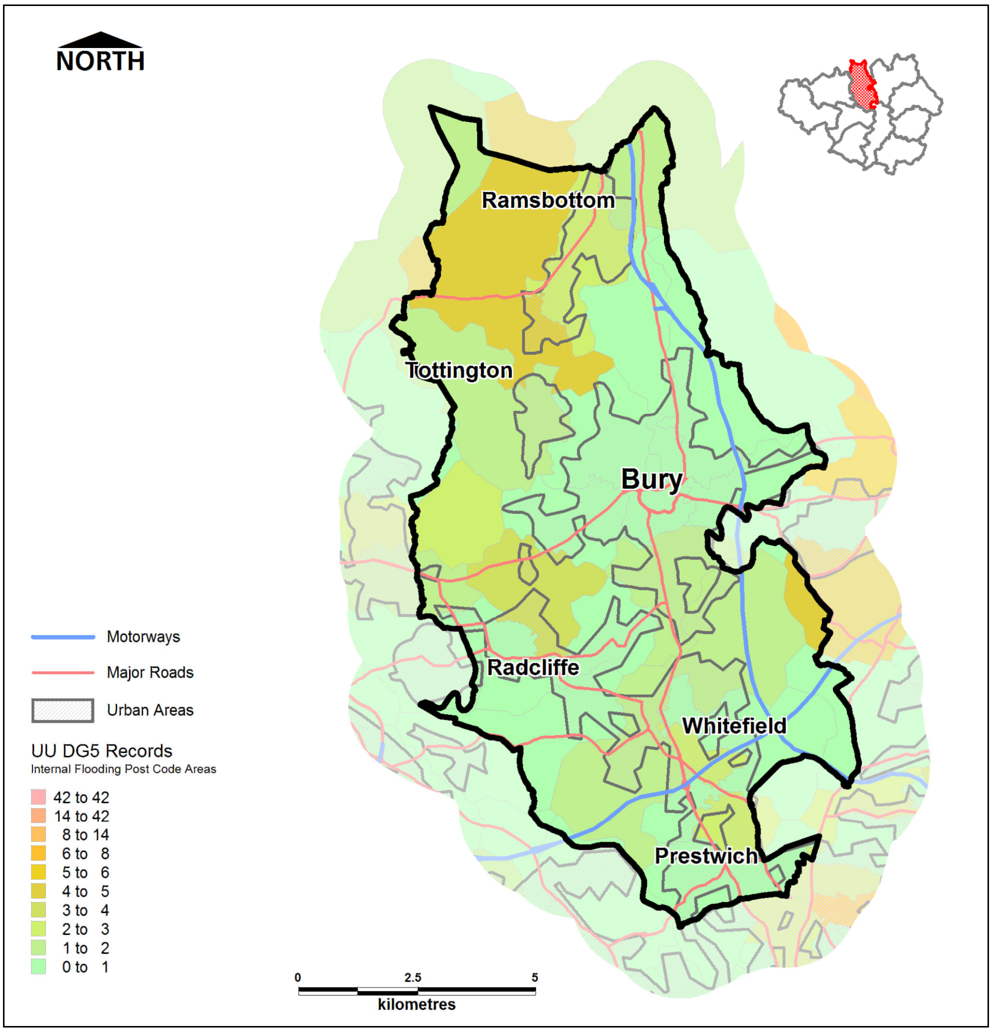


Figure 2-2: Bury UU DG5 data (June 2007) showing instances of Internal Flooding by five-digit postcode area.

Flooding from Reservoirs, Canals and Other Artificial Sources

There are a number of reservoirs upstream of the District. Reservoirs have an attenuating effect on flood flows and can be used to control flows. It should be noted that none of the reservoirs in or upstream of Bury have been designed for flood risk management, nor are they operated as such. Reservoirs do however have a flood risk associated with them in terms of dam/reservoir wall failure and emergency releases into the catchment. The likelihood of this occurring is minimal but impacts are potentially extremely high due to the limited warning time available and the potential high velocity and high volume flows.

The Bury and Bolton Canal runs through the District. 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 remains where water levels could overtop or breach embanked sections. Searches revealed that in 1936 there was a major breach of the canal on the Bury arm, which led to boats being swept from the canal summit down into the river Irwell below as the canal waters quickly drained. The canal is currently undergoing a restoration programme following its closure after the breach[10].

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.

British Geological Survey (BGS) Maps show the Bury MBC area to be underlain by more permeable rocks consisting primarily of sandstones in a small area (7.3%) to the south and southeast of the District (the Prestwich area). As a result, the EAs groundwater vulnerability maps show this area to be classed as a Major Aquifer, consisting primarily of the Permo-Triassic Sandstone. The majority of the district is underlain by the Pennine Lower Coal Measures consisting of mudstones, siltstones and sandstones and coal seams, which is classed as a Minor Aquifer. However, this is overlain by predominantly glacial till with less permeability. Superficial deposits on land following the main River Irwell valley consist predominantly of sands and gravels and are therefore more permeable.

Searches have revealed no reported incidents of groundwater flooding in Bury MBC. However, work undertaken by the EA recently[11] has suggested that the cessation of mine dewatering and the slowing of abstraction from the aquifers, has led to an increase in groundwater levels, or groundwater rebound in the Sherwood Sandstone Aquifer. According to the EAs water resources team and groundwater monitoring undertaken in the area, the risk posed by groundwater flooding is likely to remain remote. However, increased development and potential interference in local ground conditions could cause localised problems – especially those in river valleys and next to canals, where local groundwater levels may be influenced by the river and canal.

The impacts of increased development in these areas must therefore be carefully assessed. For example, larger infiltration based SuDS methods may less suitable in the glacial tills (with a high,

[10] http://www.penninewaterways.co.uk/mbb/mbbc30.htm
[11] Groundwater Flood Risk and Management in the North West Region, Environment Agency, 2007.

less permeable clay content) and may actually increase groundwater levels locally. As a result, small scale soakaways or attenuation schemes may be a more suitable SuDS method through much of Bury MBC. In addition, deep excavations for new development (for example, underground car parks and basements, or new infrastructure tunnels) should be carefully assessed to determine what risk is posed.

Fluvial Flood Zones

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 and each outline used to create the SFRA flood zones assumes that no defences exist. There are no areas of tidal flood risk within the AGMA sub-region.

However, there are areas where little or no accurate flood outlines exist, and therefore, to ensure a continuous coverage across a flood zone, less accurate, broad-scale modelled (the EA J-FLOW Flood Zones) outlines were used instead. This hybrid approach provides a conservative flood zone and highlights potential uncertainties that can either be resolved in more detail at Level 2, or by developers as part of site-specific FRAs. The SFRA has identified the following flood zones in accordance with PPS 25

Flood Zone 1: Low Probability of Flooding
Land having a less than 1 in 1000 annual probability of river 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%) in any year. Detailed modelling to determine the 1000yr flood outline has recently been completed by the EA on the River Irwell[12]. However, for the rest of Bury MBC, no detailed modelled outlines exist for Flood Zone 2 and therefore, the EA broad-scale Flood Zone 2 maps were used.

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

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. Where possible, 1:20 or 1:25 year detailed modelled outlines were used to define the functional floodplain. Some defended areas

[12] River Irwell Model Review and Update, Environment Agency, October 2007.

may include flood storage basins which are by their very nature functional floodplain. 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 in the data and potential tasks for the more detailed Level 2 assessments. 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.

Using the flood zone maps, the total area of Bury at risk of fluvial flooding can be determined. Table 2-7 and Figure A-5 show that areas of the district are at risk of fluvial flooding with approximately 7.5% of the district area affected by Flood Zones 2 and 3. As Bury MBC is located in the middle to upper reaches of the River Irwell catchment, the flood extents are less than councils located towards the lower reaches of the catchment where floodplains are naturally more extensive. However, the flood zone area equates to a little over 10% of the total urban area in Bury MBC and therefore still poses a significant issue for the council.

Table 2-7: Area of Fluvial Flood Risk to Bury MBC

District Area (ha)	Urban Area (ha)	Fluvial Flood Zone	Area (ha)	% (of District or Urban Area)
9916.21	3,331.40	FZ3b	129.23	1.19
		FZ3a	240.16	2.42
		FZ3 in Urban	157.98	4.74
		FZ3 + CC	96.98	0.98
		FZ2	392.19	3.95
		FZ2 in Urban	196.72	5.91

Note: Figures for FZ3a refer to the area outside of FZ3b, figures for FZ3+CC and FZ2 refer to the area outside of FZ3a.

Flood Zone Confidence

Flood Zone Confidence Maps are intended to be used by planners as a tool for identifying areas of high, medium or low confidence in the data that has been used to derive fluvial Flood Zones across the sub-region and also to determine where further work is required. The confidence assigned to a Flood Zone demonstrates the level of detail and the number of assumptions made when deriving the Flood Zones. The maps can be used to determine reaches of river where further, more detailed work is required to refine Flood Zones and therefore where resources should be directed.

Table 2-8 illustrates the confidence assigned to the Flood Zones present within Bury MBC. A map showing confidence in the each of the Flood Zones is presented at the end of this section (Figure Bury Overview/03).

Table 2-8: Fluvial Flood Risk Confidence for Bury MBC

<table>
<tr><th>District</th><th>Fluvial Flood Zone</th><th>Watercourse</th><th>Settlement</th><th>Source</th><th>Date of Modelling Study</th><th>Confidence</th></tr>
<tr><td rowspan="26">Bury</td><td rowspan="7">3b</td><td rowspan="4">All Other Watercourses</td><td>Whitefield</td><td rowspan="4">EA Flood Zone Maps</td><td rowspan="4">NA (May 2008)</td><td rowspan="4">Low</td></tr>
<tr><td>Radcliffe</td></tr>
<tr><td>Bury</td></tr>
<tr><td>Ramsbottom</td></tr>
<tr><td rowspan="3">River Irwell</td><td>Radcliffe</td><td rowspan="3">Irwell Review Model</td><td rowspan="3">2007 (May 2008)</td><td rowspan="3">High</td></tr>
<tr><td>Bury</td></tr>
<tr><td>Ramsbottom</td></tr>
<tr><td rowspan="8">3a</td><td rowspan="3">River Irwell</td><td>Radcliffe</td><td rowspan="3">Irwell Review Model</td><td rowspan="3">2007</td><td rowspan="3">High</td></tr>
<tr><td>Bury</td></tr>
<tr><td>Ramsbottom</td></tr>
<tr><td rowspan="4">All Other Watercourses</td><td>Whitefield</td><td rowspan="4">EA Flood Zone Maps</td><td rowspan="4">NA</td><td rowspan="4">Medium</td></tr>
<tr><td>Radcliffe</td></tr>
<tr><td>Bury</td></tr>
<tr><td>Ramsbottom</td></tr>
<tr><td>River Irwell</td><td>NA</td><td>Irwell ABD (Draft)</td><td>2008</td><td>High</td></tr>
<tr><td rowspan="5">3a + CC</td><td rowspan="3">River Irwell</td><td>Radcliffe</td><td rowspan="3">Irwell Review Model</td><td rowspan="3">2007</td><td rowspan="3">High</td></tr>
<tr><td>Bury</td></tr>
<tr><td>Ramsbottom</td></tr>
<tr><td>All Other Watercourses</td><td>NA</td><td>EA Flood Zone Maps - Flood Zone 2</td><td>NA</td><td>Low</td></tr>
<tr><td>River Irwell</td><td>Prestwich</td><td>Irwell ABD (Draft)</td><td>2008</td><td>High</td></tr>
<tr><td rowspan="5">2</td><td rowspan="4">All Other Watercourses</td><td>Whitefield</td><td rowspan="4">EA Flood Zone Maps</td><td rowspan="4">NA</td><td rowspan="4">Medium</td></tr>
<tr><td>Radcliffe</td></tr>
<tr><td>Bury</td></tr>
<tr><td>Ramsbottom</td></tr>
<tr><td>River Irwell</td><td>NA</td><td>Irwell ABD (Draft)</td><td>2008</td><td>High</td></tr>
</table>

Climate Change and Future Flood Risk

The CFMP's have 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 District. Defra/UKCIP (United Kingdom Climate Impacts Programme) 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.

According to the Irwell CFMP, Radcliffe and the Upper Irwell are shown to have a much-increased risk of flooding under climate change and urbanisation scenarios. Water levels in Radcliffe could increase by up to 0.8m and the number of properties affected increases by 30% (200 properties).

Water level at Bury increases by 0.2m, putting an additional 10 properties at risk. Water levels in Ramsbottom increase by 0.3m.

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)[13] 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 runoff during storm events. The ASSCUE 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. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

The location of future urban developments and flood defences within a catchment can influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments. It may however be possible to mitigate against this 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.

To account for Climate Change at the sub-regional level, FZ3 modelled outlines (including the effects of climate change) were obtained. Where there are no modelled climate change results, an assumption 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 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 Level 2 stage or for site-specific FRAs (developer-led).

Flood Risk Mitigation and Management

Flood Risk Management

Flood risk management assets may be hard formal structures designed for purpose such as flood walls, or they may be informal structures such as garden walls which were not designed specifically as defence structures, but are now performing that role. The National Flood and Coastal Defence Database (NFCDD) identifies any asset (including channels) that may have an impact on flood risk management and is constantly being updated and amended by the EA as a result of ongoing asset inspections. It should be noted that the database assigns a Standard of

[13] 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

Protection (SoP) to flood defence assets and has a default value of 50 Years. Therefore the SoP values should be treated with caution and assessed (in conjunction with the EA) on a site-by-site basis during the more detailed Level 2 stage. NFCDD data, along with CFMP's and council supplied information, have been used to identify the major structures and groups of flood defence assets in the District. It should be noted that raised flood defences exist along most of the length of the River Irwell, River Roch and River Croal and the list below is not intended to be an exhaustive account of FRM measures in the District.

Bridges in Radcliffe can impede flow on the Irwell at Bury

Flood alleviation scheme Ramsbottom

Defences at Buckley Wells, Redvales (Bury)

Defences at Blackford Bridge, Radcliffe

By interrogating NFCDD outputs, a series of informative statistics about flood risk assets can be obtained. For Salford City Council, data from NFCDD shows that there are over 12km of culverted watercourses and 9.2km of man made raised flood defences, 8.5km of which have a SoP of between 21 and 50 years, and 0.82km have an SoP of between 76 and 100 years (Table 2-9).

Table 2-9: NFCDD data summarising lengths of flood defence asset in the Bury CC Area (km) by Standard of Protection (return period in years).

Asset Type	Length of FRM Asset (km) by Standard of Protection in years					
	Unclassified	**0-20**	**21-50**	**51-75**	**76-100**	**Total**
Culverted Channel	0	0.00	12.16	0.00	0.22	12.37
Maintained Channel	0	0.00	0.60	0.00	0.08	0.68
Natural Channel	0	0.02	23.21	0.00	2.75	25.98
Flood Defence Structure	0	0.00	109.19	0.22	19.06	128.47
Non-Flood Defence Structure	0	0.00	1.59	0.00	0.10	1.69
Raised Defence (Man-Made)	0	0.00	8.47	0.00	0.82	9.28
Total	**0**	**0**	**155.21**	**0.22**	**23.02**	**178.48**

Mitigation

There are many different types of flood risk mitigation actions ranging from small, single dwelling flood proofing measures to flood warning services to large multi-million pound flood defence schemes.

There are flood warning areas covering the Ramsbottom area which has been an effective mitigation measure for many years. However, flood warnings tend to work most effectively during large events with long lead times so that sufficient advance notice is given to residents and businesses and are usually only applicable to fluvial flooding. In the case of intense, flashy rainfall events, where pluvial and sewer flooding may pose the most risk, flood warnings schemes rarely exist.

The River Irwell CFMP identifies potential flood storage locations in the District, just upstream of Bury which reduces water levels in Bury and Radcliffe by 0.2-0.3m, and in the adjacent District of Rochdale just upstream of the Roch/Irwell confluence at Heywood which reduces water levels by 0.25-0.4m in Blackford Bridge and Radcliffe.

Risk of Failure of Defences and Impacts

Behind defended areas there is a residual risk of 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 tend to be low lying, and the water level will have often built up to a higher level than ground levels of the defended area. The same risks can be associated with reservoir/dam failure, though the risk of such failures is considered to be minimal. Areas in Bury MBC at particular risk of defence failure include Ramsbottom, Redvale in Bury and Blackford Bridge in Radcliffe.

People and Property at risk of flooding

The EA carried out a strategic review of flood risk for the whole of the North West Region[14]. This looked at the EA Flood Zones and the number of properties at risk of flooding within each District in the North West. Table 2-10 shows the number of properties at risk of flooding in each Flood Zone.

Table 2-10:Properties at risk of flooding (source: EA Flood Zone Ranking using EA Flood Zones)

FZ3	FZ2&3	FZ1	Total
288	5,036	78,966	84,002

Using census Output Area (OA) data (the smallest census geographical area), and updated mid-term 2005 population estimates for Bury, the potential populations affected by flooding in the different flood zones are presented in Table 2-11. 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 a district, 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 a CO by the type of accommodation they live in. Again, assuming an even distribution across a CO, an indication as to the predominant types of properties at risk can be shown

[14] 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)

Table 2-11: Approximate number of people affected by fluvial flooding in Bury

	Population at Risk (2005)	People living in House Bungalow	People living in Flat or Apartment	People living in Caravans or moveable Accommodation	People living in Shared Dwelling
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	-

There appears to be a large number of people at risk in the functional floodplain. This is due, in large part, to FZ3b not being modelled in parts of the District. Consequently, FZ3a has been used as a proxy.

2.3. Strategic Overview of Flood Risk in Bury MBC

2.3.1. Consequences of Upstream and Downstream Development

Broad development upstream of Bury on the River Irwell and the within the Irwell, and Roch catchments is defined within the RSS in terms of housing figures. The five districts upstream that are connected to Bury (either directly or indirectly) hydrologically therefore have the potential to adversely affect the current flood risk in Bury. Even though the district is located towards the upstream extent of the Irwell and Roch catchments there is still potential for development both within and adjacent to, the AGMA sub-region to affect flood risk in Bury. 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.

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.

Should RSS housing targets be met, for example, a total of 35,600 new homes will be built in districts upstream of Bury. A further 109,040 homes are proposed in the 4 districts downstream of Bury Figure 2-3. These figures are for net new housing and so are additional to the current levels of development. Furthermore, all of the districts within the AGMA sub-region have a high target of development on previously developed land (PDL). As a result, if no measures are taken to control runoff from new development, there is the potential for an increase in flood risk to Bury. In reality, however, it is likely that much of the new development will be constructed to modern and sustainable standards incorporating, where possible, SuDS to limit runoff.

Downstream and adjacent to Bury are Salford CC, Manchester CC, Trafford MBC, and Warrington MBC. As discussed above (Section 2.1), development within Bury MBC is likely to follow a combination of Options 1, 2, and 3 with regards the Core Strategy's Spatial Options, as the locations are centred on existing centres and regeneration areas and in the south of the District. These areas are upstream of the Manchester, Salford and Trafford Inner Areas, the Regional Centre and the Manchester City Centre where substantial development ambitions and pressures exist. Therefore development in the District must be undertaken in such a way as to reduce the impacts on flood risk downstream.

As identified by the CFMPs, Bury contains potential areas to provide floodplain storage (for example on the Irwell, just upstream of Bury). However, to avoid reducing floodplain storage and potentially increasing flood risk downstream, development within and adjacent to these areas must be undertaken carefully so as not to adversely affect flood storage or flood flow routes. In addition, the incorporation of green open spaces and SuDS measures may help to reduce increased runoff.

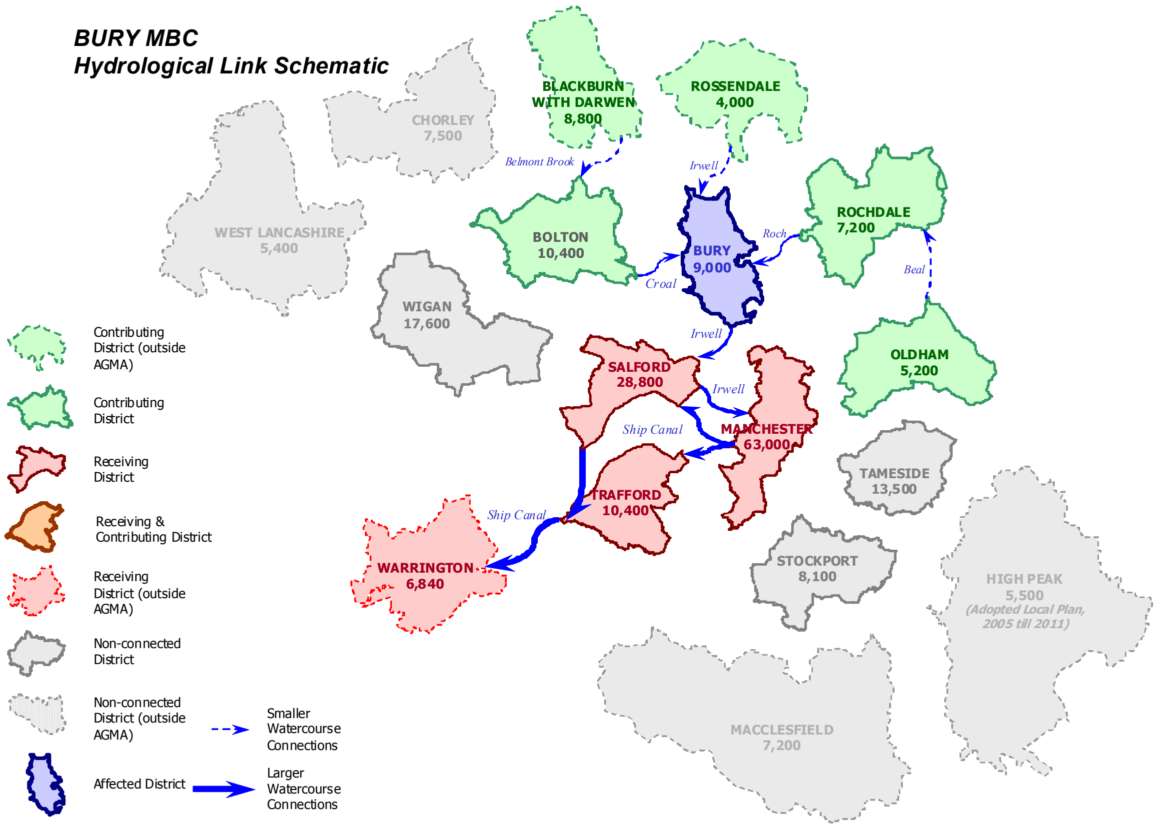


Figure 2-3: Hydrological Links for Bury MBC

2.3.2. Potential Conflicts between broad development aspirations in Bury MBC and the PPS25 Sequential Test

As highlighted above, the current flood risk to the district is primarily from fluvial sources, in particular the River Irwell and Roch. In addition, there is at present an unquantified risk of flooding from the Bolton and Bury Canal. Most of the potential development locations are situated outside of the main flood zones, however, with the main urban areas situated along and adjacent to the river valleys there are areas of potential development, particularly in the Radcliffe area that lie within Flood Zones 2 and 3.

Most of the proposed development areas include some of the most densely populated areas in Bury. Therefore, there is potential for an increase in the amount of impermeable area and the subsequent increases in runoff and the impacts on surface water and sewer flooding. Using UU data and the Urban Morphology Types (UMT) boundaries from the ASSCUE project, the percentage of impermeable areas within the district can be identified and it is recommended that the risks associated with potential surface water (pluvial) and sewer flooding in these areas is examined in more detail at Level 2 stage.

As a result, potential conflicts exist between development and the PPS25 Sequential Test in these areas. In order to examine these in more detail, it will be necessary to create maps showing more detailed flood outlines taking into account functional floodplain and climate change (as per PPS25 requirements) and displaying the risk associated with the Bolton and Bury Canal during Level 2 assessments.

2.3.3. Impacts on and from other strategic spatial considerations

Other spatial considerations that Bury MBC should take account of with regards to flood risk include the Greater Manchester Green Infrastructure Scoping Study 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 areas on the Irwell upstream of Bury that have a building density of less than 1.25%. This correlates with the Irwell CFMP findings on potential for storage in the catchment. It is important that such 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.

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.

Waste and hazardous substances can also be affected by flooding and potentially introduce harmful and polluting substances into flood waters for transport and distribution elsewhere. The Greater Manchester Waste DPD is currently being undertaken and identifies current and future areas for waste management, storage and transfer. Using this in conjunction with the SFRA may help to reduce the risk of flooding to waste sites.

2.3.4. Strategic Effects of Defence failure

Impacts of defence failure include fast flowing, deep water which has the potential to cause major damage and loss of life within the District. At this time, it is not thought that the impacts of defence failure in Bury will adversely impact on districts downstream. In fact, the increase in flood storage to the catchment as a result of lateral defence failure can reduce flood risk downstream. Failure of defences could however increase flooding locally.

If flood storage areas are taken forward as recommended in the Irwell CFMP, there will be a residual risk of either structural or operational failure. This could have the effect of releasing a large volume of water into the catchment very quickly and therefore increase flood risk downstream.

2.3.5. Identifiable strategic mitigation options

Strategic options for mitigation include the upstream flood storage schemes. The River Irwell CFMP identifies potential flood storage locations in the District, just upstream of Bury which reduces water levels in Bury and Radcliffe by 0.2-0.3m, and in the adjacent District of Rochdale just upstream of the Roch/Irwell confluence at Heywood which reduces water levels by 0.25-0.4m in Blackford Bridge and Radcliffe, which could decrease damages in the Bolton and Kearsley areas by 3-5%.

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 catchment is reduced. Furthermore, and working closely with the outputs from the current sub-regional Green Infrastructure study, careful land use planning and the gradual reinstatement of green open spaces together with wetlands and woodlands throughout the catchment may help to further reduce runoff.

Bury_Overview/01

Bury_Overview/02

Bury_Overview/03

3. Manchester City Council

3.1. Manchester Development and Planning Context

Manchester is the North West Region's principal city. It has an international reputation in commerce, business, culture, higher education and media, and forms a key centre for economic activity. It has seen substantial investment which has resulted in the creation of major cultural facilities, regeneration of declining neighbourhoods, the refurbishment and development of notable buildings and open spaces. Manchester is an international destination and is seeking to consolidate its position as the emergent Knowledge Capital for the region. Manchester is also one of the English Core Cities and is considered by many as England's second city after London.

The City of Manchester is located in the south of the Greater Manchester conurbation and covers an area of about 11,565 hectares. Though it is largely urbanised, the southern part of the city meets the Cheshire countryside. The city has a diverse population of 441,200 (ONS). A map presenting planning information for Manchester is included at the end of this section (Figure Manchester Overview/02).

3.1.1. Strategic and Regional Position

The RSS is informed by the Northern Way Growth Strategy which focuses principally on the eight Northern City Regions that harbour the majority of assets and growth potential. In summary, paragraph 2.3 in Part 1 of the Regional Spatial Strategy identifies the Manchester City Region within the north-west as having the largest sub-regional economy, representing the greatest potential for boosting economic performance in the North-West to address the North/South disparities. The Manchester City Region, particularly the Regional Centre (as defined within the RSS), are recognised as being the "...economic engines, providing the significant portion of additional housing and other development required for the economic growth envisaged for the Region".

The Regional Spatial Framework, Policy RDF1 states that Plans and Strategies are to support the concentration of most of the new development within the urban areas of the Regional Centres. This is to reflect their role as key economic drivers and their capacity to cope, 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.

3.1.2. Unitary Development Plan

The Unitary Development Plan (UDP) was first adopted in 1995. Since its adoption the Council has made a series of alterations to some of its policies in response to changing circumstances.

Further, since 1997 the Council has adopted a series of Supplementary Planning Guidance documents including; SPG A Guide to Development in Manchester, SPG City Centre Bomb Damaged Area, SPG Special Needs Housing, SPG Ancoats Urban Village and SPG East Manchester.

Policies in the current UDP were saved automatically for three years under the Planning and Compulsory Purchase Act. This period came to an end in September 2007, but the City Council is retaining relevant policies in the UDP beyond the three years until such a time as the UDP policies are replaced by Development Plan Documents.

The adopted Manchester City Council UDP, which sets out the planning policies and proposals for the City Council. Part I will be saved until the Core Strategy is adopted, whilst Part II will be saved until the Core Strategy and Site Specific Allocation Development Plan Documents replace allocations in the UDP.

The Secretary of State issued a direction in September 2007 setting out which policies will remain saved. These are policies which fulfil the following criteria: they reflect the principles of local development frameworks; are consistent with the Regional Spatial Strategy and the Manchester Sustainable Community Strategy; and that it has not been feasible or desirable to replace them by 27th September 2007.

3.1.3. Local Development Framework

Timetable

With respect to the Local Development Framework, the following new Local Development Documents will be produced by the Council:-

- Statement of Community Involvement
- Core Strategy Development Plan Document
- Site Specific Development Plan Documents – this DPD identifies sites to be allocated for specific uses with related policies;
- Proposals Maps – identify areas of protection and sites to which particular land use and policies apply.

Furthermore, the Council intends to produce a number of Supplementary Planning Documents - comprising design guides, area development briefs or issue-based documents to supplement policies in the development plan document. These do not form part of the statutory development plan.

The City Council has chosen to prepare the Core Strategy, the Site Specific Allocation Development Plan Document and the Proposals Map in parallel up to the preferred options stage. It has chosen to do this to create a more coherent Plan with the Core Strategy setting out the City-wide context, followed by implementation in the form of the Site Specific Allocations and Proposals Map. These three documents will be based on the same baseline information ensuring consistency and the more efficient use of the Council's resources.

After the preferred options stage the submission stage will be staggered to consider the Core Strategy separately to the Site Specific Allocation Development Plan Document and allow the recommendations of the Core Strategy Examination to feed into the subsequent Site Specific Allocation Examination.

Each of the ten Greater Manchester authorities has agreed to the principle of joint working to inform the preparation of their waste development plan documents. A joint Committee at the Greater Manchester level has been set up and work is commencing on this document.

Regeneration Activity

The city is presently experiencing wide ranging regeneration activity which consists of a number of regeneration areas, namely North, East, Central, South and Wythenshawe. They are at different stages of their strategies and are delivering a range of initiatives that vary from Housing Market Renewal to New Deal for Communities and Sure Start.

Housing Land

The level of housing activity within the Regional Centre both reflects and underpins its role as a key driver for economic activity within Manchester City Region. Housing trajectories indicate a record increase in housing units completed for the period 2001-2 to 2005-6, with a net total for the period of 11,680. There are just under 12,000 units to complete on sites under construction and a further 14,000 units within the planning pipeline, residential completions are set to continue to rise within the city. The Council anticipated demolitions of around 500-600 units per annum over the next 3-4 years and net completions will be above 3,300 units per annum in the short term and are likely to reach 3,700-3,800 within two to three years. Housing capacity studies have shown that this level of activity is achievable over the period of the plan.

Key to development activity is Manchester's Housing Market Renewal activity within the east and northern areas, where clearance will provide the opportunity for more intensive new development. Together with development activity within the city centre and windfall opportunities throughout the city, the city is expected to achieve its draft RSS annual requirement of 3,500 units.

Table 3-1 Regional Spatial Strategy Targets - 2003 – 2021

	Target
Overall Housing Increase 2003-21	63,000
Mean Annual Increase	1,350
Indicative Previously Developed Land	90%

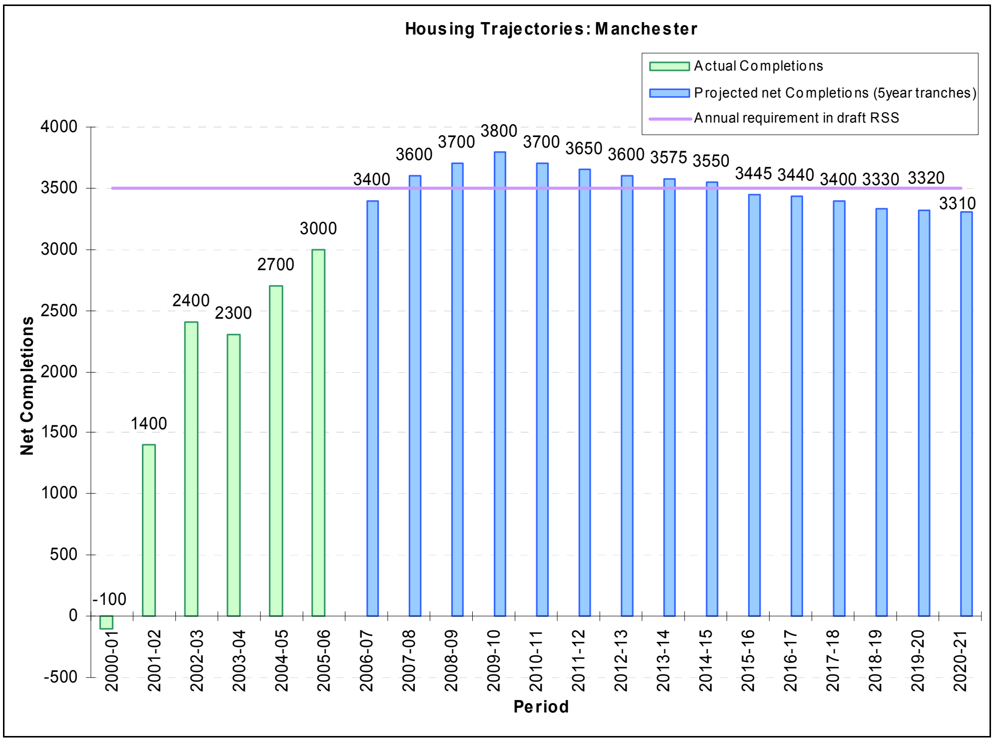


Figure 3-1: Housing Trajectories

Employment Land

There are potentially 172 ha of land available for employment development throughout the city, including sites within the city centre. Broadly, it is expected that development will most likely occur within the regeneration areas in the Inner Area neighbourhoods of the city such as Central Park and Sports City, but also Manchester Airport. An existing assessment of employment land is yet to be conducted which would give a more comprehensive picture of land availability.

Transport and Urban Infrastructure

Manchester Airport – In response to the Governments Aviation White Paper (2003), Manchester Airport has produced a Manchester Airport Master plan to 2030. Manchester Airport is identified as one of the key drivers of regional growth and a central challenge it faces is achieving and delivering sustainable growth. The Master Plan sets out the main challenges and opportunities particularly where the Airport will impact on the surrounding neighbourhoods. Essentially, the airport is seeking to combine necessary improvements to the operational areas whilst creating more jobs and bringing economic prosperity to local people.

Irwell City Park – Manchester City Council, Salford City Council and Trafford Metropolitan Borough Council have come together to produce a joint Planning Guidance document to inform and guide development within the vicinity of the River Irwell. Their vision is to see the restoration of the River to create a new and exciting urban park, focusing on its spectacular industrial and architectural achievements, attracting new waterfront development and activities and linking neighbourhoods and communities with the heart of the City Centre. The transformation will create dramatic public spaces, new waterside environments and new connections between the riverside and local neighbourhoods and businesses.

3.2. Manchester Flood Risk Summary

3.2.1. Hydrological background: catchment and watercourse network

The City of Manchester lies at the south of the Greater Manchester sub-region, which is situated in the lower reaches of the Rivers Irwell and Mersey and is consequently low lying and has relatively flat topography. Other main watercourses within the City Council administrative area include the Rivers Bollin, Irk, Medlock and the Manchester Ship Canal. All of these watercourses carry with them an inherent potential flood risk. The urban areas at greatest risk from flooding in the Manchester are City Centre, Didsbury, Northenden and Fallowfield. The River Irwell CFMP and Draft Upper Mersey CFMP cover the City Council area and are used by the EA to inform flood risk management strategy within a catchment. Both CFMPs also provide flood risk information of particular relevance to Manchester that can be used to increase the quality and accuracy of flood risk information presented in the SFRA. A map presenting flood risk information for Manchester is included at the end of this section (Figure Manchester Overview/01). Table 3-2 shows the main watercourses and urban areas at risk of flooding from each.

Table 3-2: Watercourse and Urban Area at Risk

Main Watercourses	Urban area at risk
Manchester Ship Canal	Manchester
Chorlton Brook	Chorlton-cum- Hardy
Mersey	Northenden, Didsbury
Baguley Brook	Baguley
Irwell	Manchester
Irk	Manchester
Medlock	Manchester, Droylsden

3.2.2. Historical Flooding

A review of the information supplied by the council, the EA, CFMP's, and through searching online historical records[15], has revealed that Manchester has experienced a number of flood events throughout the last century. Historically the District has experienced river flooding predominantly from the Mersey and pluvial and sewer flooding from localised intense rainfall events. Records show that most significant fluvial flood events occurred prior to 1911. Although fluvial flooding has occurred following 1911, more frequent pluvial and sewer flooding has occurred. This could be as a result of increased industrialisation and subsequent increased flood risk management measures. Interestingly, most flooding to affect MCC has occurred during late autumn/early winter (predominantly fluvial events) or late summer (predominantly pluvial and sewer events). Table 3-3 shows a number of significant historical flood events.

[15]British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe/

Table 3-3: Significant Historical Flood Events

Date	Location	Source of Flooding	Impact	Source of Information
August 1799	River Irk, North Manchester	Fluvial	Flooding to the lower Irk Valley. Roads and properties affected.	BHS Database
December 1860	River Medlock, City Centre, Hulme	Fluvial	Flooding to properties and roads	BHS Database
November 1866	River Medlock, City Centre, Hulme	Fluvial	Damage to properties in Manchester City	BHS Database
July 1872	River Medlock, Mersey and Irk, City Centre, Hulme, North Manchester, Northenden, Didsbury	Fluvial / Bridgewater Canal	Extensive flooding to properties in the lower lying areas along the Medlock and Mersey. Medlock overtopping into Bridgewater canal. Barges in canal lifted out.	BHS Database
1890	River Mersey, Northenden and Didsbury	Fluvial	Flood damage caused near Northenden and Didsbury	BHS Database
August 1911	River Mersey, Moss Side and Withington, Fallowfield	Fluvial, Sewer and Pluvial Flooding	Flooded sewage works	BHS Database
July 1947	Wilbraham	Pluvial and Sewer	Flooded rail station and line	BHS Database
June 1958	Ardwick, Wilbraham, Fallowfield	Pluvial and Sewer	Flooded rail station	BHS Database
December 1965	River Mersey, Northenden and Didsbury	Pluvial and Sewer, Fluvial	Flooded property and evacuations, Sewers burst	BHS Database
August 2004	Chorlton Brook, Manchester University, Fallowfield	Fluvial, Pluvial and Sewer	Flooded halls of residence and homes in Fallowfield	Manchester Evening News Article

3.2.3. CFMP Assessment of Flood Risk

MCC is covered by the draft Upper Mersey CFMP and the River Irwell CFMP. Draft policies are subject to change and the SFRA must be adapted accordingly. CFMP's have split overall flood risk in MCC into nine spatial areas, each assigned with a degree of risk (high, medium and low) as displayed in Table 3-4. The CFMPs have also recommended a preferred policy option number for each unit. The generic policy options are shown in Table 3-5.

Table 3-4: Policy units and preferred policy

Policy Unit	Policy Option	CFMP	Risk
PU2 Bollin	3	Upper Mersey	Medium/Low
PU4 Mersey	5	Upper Mersey	High
PU5 Upper Sinderland	4	Upper Mersey	High
PU8 Outliers	4	Upper Mersey	Low
1: Manchester to Irlam (MSC)	4	River Irwell	Low
2: Manchester city centre (Irwell)	5/4	River Irwell	Low
3. Salford flood risk area (Irwell)	5	River Irwell	High
12:South Oldham to Droylsden (Medlock)	6	River Irwell	Low
11.Bradford and Deansgate (Medlock)	5	River Irwell	High

Table 3-5: Generic CFMP Policy

Policy 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)

3.2.4. Current and Future Flood Risk in Manchester CC

Identification of Flood sources

Flooding from Rivers

The historic flood event search, the EA, the City Council, and the CFMP all suggest that the there is flood risk within MCC as a result of fluvial flooding. Lower reaches of rivers in the catchment tend to be at risk from fluvial flooding attributed to prolonged rainfall activity as the naturally flatter topography drains a larger catchment area. Areas surrounding confluences of tributaries and main channels such as the confluence of the Irk and Irwell in the Castlefield area have an increased flood risk, particularly if flood peaks on both watercourses coincide or flow exceeds culvert capacity.

Manchester City Centre tends to also be vulnerable to short term intense rainfall, as the tributaries of the Medlock and Irk are small and flashy. As Manchester is a heavily urbanised area, many watercourses are culverted in sections and so flooding due to flow restrictions, which can be attributed to sedimentation and blockage of structures and weirs, is a risk and a known issue. This type of flooding is primarily found upstream of structures when water backs up behind the blockage and ultimately overtops the channel.

Flooding from the Land

During periods of prolonged rainfall events and sudden intense downpours, overland flow from adjacent higher ground may ‘pond’ in low-lying areas of land without draining into watercourses, surface water drainage systems or the ground. Evidence from the historical records search suggests that pluvial and surface water flooding has occurred in the City Centre, Wilbraham, Fallowfield and Ardwick. Pluvial and surface water flooding is most likely to occur in areas of poor permeability and limited drainage and on steeper slopes. 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.

Flooding from Sewers

Sewer and drainage flooding are another flood risk throughout MCC, particularly during severe rainfall events, where the design capacity of the sewer network is insufficient to cope with the high volumes of water. This is a known issue in Didsbury, Northenden, Wilbraham, and areas of the City Centre. During periods of high river flow, there is the potential for such drainage systems to become ‘tide locked’ and unable to discharge to the watercourse. The water then backs up and will again start to discharge. Some instances of sewer flooding were identified using historical records from United Utilities DG5 database (June 2007) detailing the total number of flood events that affected both internal and external property.

It should be noted that much of the sewer network is thought to date 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 the WRC "Sewers for Adoption"[16] 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 this design standard is not achieved. It is therefore likely that much 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.

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) (Figure 3-2) 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 that is also covered by the Data Protection Act (1998). According to the data, MCC had 75 recorded internal sewer flooding incidents and 35 external – this reflects the level of urbanisation within the council. However, DG5 data is a "snapshot" in time and may therefore have missed a significant rainfall event. As a result, a detailed analysis of the scale and consequences of sewer flooding has not been possible at this stage of the SFRA.

However, during the course of this study, 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 and AGMA have agreed to share data on drainage and development areas initially for Bury and Salford. This will allow both UU and AGMA to determine the usefulness of the data and to agree how it can be spatially represented on a sub-regional and strategic basis for the whole of the AGMA area. It is anticipated that both UU and AGMA will have agreed the scale and format of the data in time for more detailed Level 2 assessments.

Flooding from Reservoirs, Canals and Other Artificial Sources

There are a number of reservoirs in and upstream of the District such as the Gorton Upper and Lower Reservoirs. Reservoirs have an attenuating effect on flood flows and can be used to control flows. Reservoirs do however have a flood risk associated with them in terms of dam/reservoir wall failure and emergency releases into the catchment. The likelihood of this occurring is minimal but impacts are potentially extremely high due to the limited warning time available and the potential high velocity and high volume flows.

The Manchester Ship Canal, the Rochdale Canal, the Bridgewater Canal and the Ashton Canal run through the District. There are few recorded instances of flooding from the canal networks as

[16] Sewers for Adoption, Wrc Publications 2006

they tend to be heavily regulated and controlled. However, the Bridgewater Canal at Castlefield is known to have flooded in the past and to pose a future risk of flooding. Nonetheless, flood risk from canals and navigable waterways still remains where water levels could overtop or breach embanked sections. 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.

In depth discussions have been held with MSCC to determine what, if any, flood risk information and knowledge is available for strategic planning purposes in the SFRA. MSCC commissioned a detailed modelling exercise of the canal[17] to determine how the canal will react during a flood event and to enable the most efficient operational response. This exercise is nearing completion though the full results are not expected until the end of the autumn of 2007. Once the study is complete, MSCC intend to provide the information to the EA to review and determine the flood risk issues. 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. This is expected to happen during Level 2 of the SFRA.

Flooding from Groundwater

British Geological Survey (BGS) Maps show the MCC area to be underlain by more permeable rocks consisting primarily of mudstones, siltstones and sandstones. As a result, the EAs groundwater vulnerability maps show that much of the MCC area through which the Mersey, Medlock, Irk and Chorlton Brook flow is classed as a Major Aquifer, consisting primarily of the Permo-Triassic Sandstone Aquifer (57% of MCC is classed as a highly vulnerable major aquifer, whilst 20% is classed as highly vulnerable minor aquifer).

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.

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

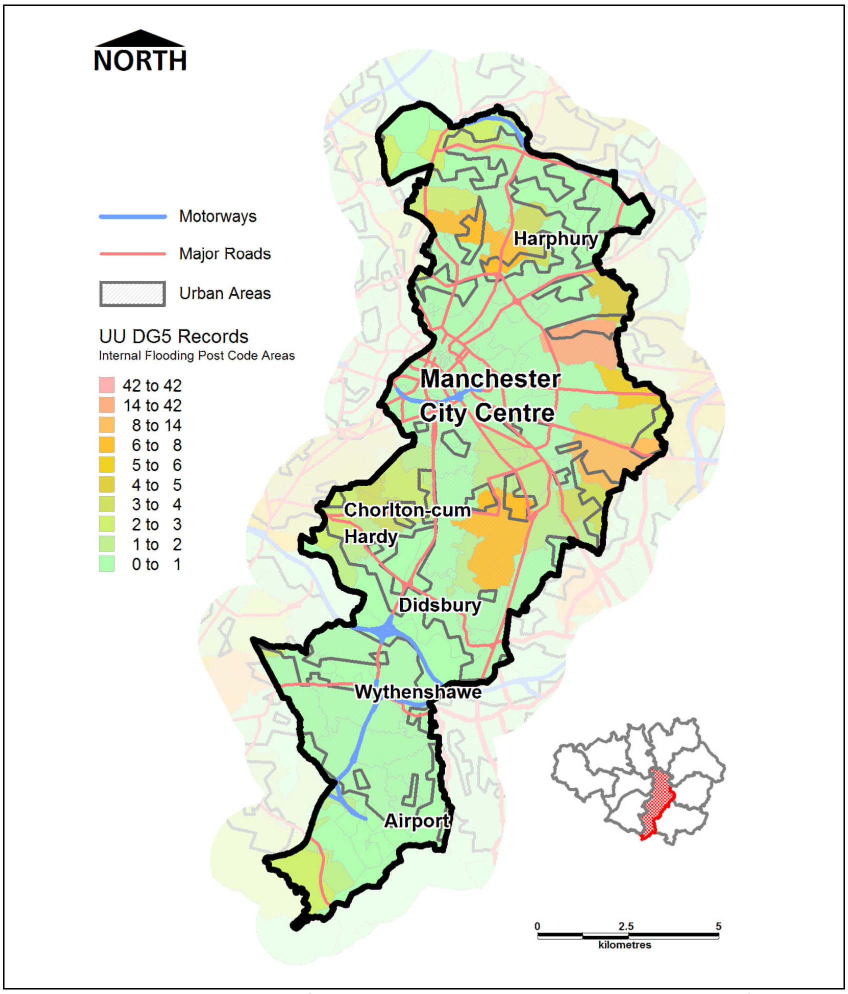


Figure 3-2: Manchester UU DG5 data (June 2007) showing instances of Internal Flooding by five-digit postcode area.

Searches have revealed no reported incidents of groundwater flooding in MCC. However, work undertaken by the EA recently[18] has suggested that the cessation of mine dewatering and the slowing of abstraction from the aquifers, has led to an increase in groundwater levels, or groundwater rebound.

According to the EAs water resources team and groundwater monitoring undertaken in the area, the risk posed by groundwater flooding is likely to remain remote. However, this could become more of an issue in certain areas of MCC due to the rising groundwater levels and the major aquifer – especially those in river valleys and next to canals, where local groundwater levels may be influenced by the river and canal.

The impacts of increased development in these areas must therefore 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.

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

Similarly, deep excavations for new development (for example, underground car parks and basements, or new infrastructure tunnels) should be carefully assessed to determine what risk is posed.

Fluvial Flood Zones

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 and each outline used to create the SFRA flood zones assumes that no defences exist. There are no areas of tidal flood risk within the AGMA sub-region.

However, there are areas where little or no accurate flood outlines exist, and therefore, to ensure a continuous coverage across a flood zone, less accurate, broad-scale modelled (the EA J-FLOW Flood Zones) outlines were used instead. This hybrid approach provides a conservative flood zone and highlights potential uncertainties that can either be resolved in more detail at Level 2, or by developers as part of site-specific FRAs. The SFRA has identified the following flood zones in accordance with PPS 25

Flood Zone 1: Low Probability of Flooding
Land having a less than 1 in 1000 annual probability of river 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%) in any year. Detailed modelling to determine the 1000yr flood outline has recently been completed by the EA on the River Irwell[19]. However, for the rest of MCC, no detailed modelled outlines exist for Flood Zone 2 and therefore, the EA broad-scale Flood Zone 2 maps were used.

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

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. Where possible, 1:20 or 1:25 year detailed modelled outlines were used to define the functional floodplain. Some defended areas may include flood storage basins which are by their very nature functional floodplain. As agreed with AGMA and the EA, if detailed modelled outlines did not exist, then the SFRA

[19] River Irwell Model Review and Update, Environment Agency, October 2007.

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 in the data and potential tasks for the more detailed Level 2 assessments. 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.

Using the flood zone maps, the total area of Manchester at risk of fluvial flooding can be determined. Table 3-6 and Figure A-5 show that some significant areas are at risk of fluvial flooding, with nearly 11.5% of the district area affected by flood zones 2 and 3, which accounts for 7.5% of the urban area.

Table 3-6: Area of Fluvial Flood Risk to Manchester City Council

District Area (ha)	Urban Area (ha)	Fluvial Flood Zone	Area (ha)	% (of District or Urban Area)
11,527.50	7,920.87	FZ3b	465.04	4.03
		FZ3a	284.16	2.42
		FZ3 + CC	349.14	3.03
		FZ3 in Urban	355.42	4.49
		FZ2	560.31	4.86
		FZ2 in Urban	357.92	4.52

Note: Figures for FZ3a refer to the area outside of FZ3b, figures for FZ3+CC and FZ2 refer to the area outside of FZ3a.

Flood Zone Confidence

Flood Zone Confidence Maps are intended to be used by planners as a tool for identifying areas of high, medium or low confidence in the data that has been used to derive fluvial Flood Zones across the sub-region and also to determine where further work is required. The confidence assigned to a Flood Zone demonstrates the level of detail and the number of assumptions made when deriving the Flood Zones. The maps can be used to determine reaches of river where further, more detailed work is required to refine Flood Zones and therefore where resources should be directed.

Table 3-7 illustrates the confidence assigned to the Flood Zones present within Manchester CC. A map showing confidence in the each of the Flood Zones is presented at the end of this section (Figure Manchester Overview/03).

Table 3-7: Fluvial Flood Risk Confidence for Manchester CC

District	Fluvial Flood Zone	Watercourse	Settlement	Source	Date of Modelling Study	Confidence
Manchester	3b	Chorlton Brook, Platt Brook, Gore Brook	Chorlton-cum-Hardy	Chorlton SFRM CPG	2008 (May 2008)	High
			Rusholme			
		Cringle Brook	Withington	Chorlton SFRM Cringle	2008 (May 2008)	High
		Baguley Brook	Baguley	Upper Mersey S105 Model	2001 (May 2008)	Low
		All Other Watercourses	Manchester	EA Flood Zone Maps	NA (May 2008)	Low
		River Irk	Manchester	Irk FRM Model	2003 (May 2008)	High
	3a	Baguley Brook	Baguley	Upper Mersey S105 Model	2001	High
			Brooklands			
		All Other Watercourses	Didsbury	EA Flood Zone Maps	NA	Medium
			Manchester			
		River Irwell, River Irk	Manchester	Irwell ABD (Draft)	2008	High
		Chorlton Brook, Platt Brook, Gore Brook	Chorlton-cum-Hardy	Chorlton SFRM: CPG	2008	High
			Rusholme			
		Cringle Brook	Withington	Chorlton SFRM: Cringle	2008	High
	3a +CC	All Other Watercourses	Manchester	EA Flood Zone Maps - Flood Zone 2	NA	Low
		Chorlton Brook, Platt Brook, Gore Brook	Chorlton-cum-Hardy	Chorlton SFRM: CPG	2008	High
			Rusholme			
		Cringle Brook	Withington	Chorlton SFRM: Cringle	2008	High
			Strangeways	Irwell ABD (Draft)	2008	Low
		River Irk	Manchester	Irk FRM	2003	High
	2	River Irwell	Manchester	Irwell ABD (Draft)	2008	High
		All Other Watercourses	Didsbury	EA Flood Zone Maps	NA	Medium
			Manchester			
		Chorlton Brook, Platt Brook, Gore Brook	Chorlton-cum-Hardy	Chorlton SFRM: CPG	2008	High
			Rusholme			
		Cringle Brook	Withington	Chorlton SFRM: Cringle	2008	High

Climate Change and Future Flood Risk

The CFMP's have 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 CFMPs to test sensitivity to the flood risk drivers across the catchments affecting MCC. Defra/UKCIP (United Kingdom Climate Impacts Programme) 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.

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)[20] 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 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. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

The location of future urban developments and flood defences within a catchment can influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments.

To account for Climate Change at the sub-regional level, 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 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 Level 2 or Site Specific SFRAs (developer led).

Flood Risk Mitigation and Management

Flood Risk Management

Flood risk management assets may be hard formal structures designed for purpose such as flood walls, or they may be informal structures such as garden walls which were not designed specifically as defence structures, but are now performing that role. The National Flood and Coastal Defence Database (NFCDD) identifies any asset (including channels) that may have an impact on flood risk management and is constantly being updated and amended by the EA as a result of ongoing asset inspections. It should be noted that the database assigns a Standard of Protection (SoP) to flood defence assets and has a default value of 50 Years. Therefore the SoP values should be treated with caution and assessed (in conjunction with the EA) on a site-by-site basis during the more detailed Level 2 assessments. NFCDD data, along with CFMP's and council supplied information, have been used to identify the following major structures and flood defences assets in the District. Main river flood risk management assets are located at:

[20] 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

Culverts and weirs: Numerous culverts and weirs on all watercourses- risk of collapse

Flood Control: The River Mersey Flood Alleviation Scheme included flood risk management works over a 20km reach between Stockport and Sale and including Manchester. Raised defences (formal, informal and natural) and flood control structures exist along the Mersey (East and West Didsbury, Northenden), Irk (Vale Park), Chorlton Brook and Medlock Main Rivers as well as numerous COWs.

Storage Basin: Didsbury flood storage basin and flood control structures.

The SoP offered by the various flood defences varies along the length of a watercourse and also throughout the catchment. Defences designed to a certain SoP may, over time, decrease in standard due to normal deterioration in asset condition and the impacts of climate change such as increased flows.

By interrogating NFCDD outputs, a series of informative statistics about flood risk assets can be obtained. For Manchester City Council, data from NFCDD shows that there are over 19.5km of culverted watercourses (one of the largest in the AGMA sub-region) and 19.5km of man made raised flood defences, 7.3km of which have a SoP of between 51 and 75 years (Table 3-8).

Table 3-8: NFCDD data summarising lengths of flood defence asset in the Manchester CC Area (km) by Standard of Protection (return period in years).

Asset Type	Length of FRM Asset (km) by Standard of Protection in years					
	Unclassified	**0-20**	**21-50**	**51-75**	**76-100**	**Total**
Culverted Channel		0.17	17.18	2.29	0.00	**19.64**
Maintained Channel		0.16	1.85	0.00	0.00	**2.02**
Natural Channel		4.23	38.69	3.92	0.17	**47.02**
Flood Defence Structure		0.50	21.69	7.28	0.00	**29.47**
Non-Flood Defence Structure		0.01	0.45	0.04	0.00	**0.50**
Raised Defence (Man-Made)		5.48	13.96	0.00	0.10	**19.53**
Total		**10.55**	**93.82**	**13.53**	**0.27**	**118.18**

Mitigation Measures

There are many different types of flood risk mitigation actions ranging from small, single dwelling flood proofing measures to flood warning services to large multi-million pound flood defence schemes. There are flood warning areas on the Mersey covering the Didsbury, Northenden and Barlow Moor areas, and on the Irwell covering the Strangeways area that have been an effective mitigation measure for many years. However, flood warnings tend to work most effectively during large events with long lead times so that sufficient advance notice is given to residents and businesses and are usually only applicable to fluvial flooding. In the case of intense, flashy rainfall events, where pluvial and sewer flooding may pose the most risk, flood warnings schemes rarely exist.

Risk of Failure of Defences and Impacts

Behind defended areas there is a residual risk of 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 tend to be low lying, and the water level will have often built up to a higher level than ground levels of the defended area. The same risks can be associated with reservoir/dam failure, though the risk of such failures is considered to be minimal.

People and Property at risk of flooding

The EA carried out a strategic review of flood risk for the whole of the North West Region[21]. This looked at the EA Flood Zones and the number of properties at risk of flooding within each local authority in the North West Region. Table 3-9 shows the number of properties at risk of flooding in each flood zone.

Table 3-9: Properties at risk of flooding (source: EA Flood Zone Ranking using EA Flood Zones)

FZ3	FZ2&3	FZ1	Total
10,499	16,319	195,663	211,982

Using census Output Area (OA) data (the smallest census geographical area), and updated mid-term 2005 population estimates for MCC, the potential populations affected by flooding in the different flood zones are presented in Table 3-10. 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 a local authority, 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 a CO by the type of accommodation they live in. Again, assuming an even distribution across a CO, an indication as to the predominant types of properties at risk can be shown.

Table 3-10: Approximate number of people affected by fluvial flooding in Manchester

	Population at Risk (2005)	People living in House Bungalow	People living in Flat or Apartment	People living in Caravans or moveable Accommodation	People living in Shared Dwelling
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

From these coarse statistics, it is can be seen that the majority of people potentially affected by fluvial flooding in Manchester reside in detached houses or bungalows in flood zone 3 and flood zone 2. It should be noted that for some parts of MCC, the 1:20 year or 1:25 year (FZ3b) modelled flood outline is not yet available and therefore the 1:100 year (FZ3a) outline was used as a proxy until FZ3b modelled outlines are available. As a result, the proportion of the population affected by

[21] 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)

FZ3b is particularly high in the figures above. However, whilst the total areas affected by flooding (Table 3-6) in MCC is less than other districts, the potential populations affected by flooding are the largest in the AGMA sub-region due to the high population densities.

3.3. Strategic Overview of Flood Risk for Manchester CC

3.3.1. Consequences of Upstream and Downstream Development

Broad development upstream of Manchester within the Mersey, Irwell and Irk catchments is defined within the RSS in terms of housing figures. The districts upstream that are connected to Manchester hydrologically therefore have the potential to adversely affect the current flood risk. 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 11 districts, both within and adjacent to (either directly or indirectly), the AGMA sub-region to affect flood risk in Manchester (Figure 3-3).

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.

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.

Should RSS housing targets be met, for example, a total of 107,700 new homes will be built in districts upstream of Manchester. A further 46,040 homes are proposed in districts downstream of Manchester. These figures are for net new housing and so are additional to the current levels of development. Furthermore, all of the districts within the AGMA sub-region have a high target for development on previously developed land (PDL). As a result, if no measures are taken to control runoff there is a potential for some of the new development to cause an increase in flood risk to Manchester. The City Council has the largest housing target (63,000) under the RSS within the sub-region, with much of the proposed development areas either in the Manchester Inner Area, the Regional Centre, Manchester City Centre, Wythenshawe and Manchester Airport. The River Irk, River Irwell, Baguley Brook, Chorlton Brook and the River Medlock all flow through these areas. The River Mersey dissects the City Council between the Manchester Inner Area (including the Regional Centre and the City Centre) to the north and Manchester International Airport to the south.

Downstream and adjacent to Manchester are Trafford MBC and Salford CC. Development and expansion aspirations within Manchester, as identified above in Section 3.1.2, are large and ambitious. Forming the key part of the Regional Centre and Inner Area (MCR2) in the RSS, which are adjacent to major watercourses, means that development in Manchester has the potential to impact on the flood risk of downstream and adjacent councils.

In reality, however, it is likely that new development will be constructed to modern and sustainable standards following current best practise guidelines and policy (PPS25) and incorporating, where possible, SuDS to limit runoff. This will remain a challenge for development in Manchester CC due to the density and scale of development, the 90% PDL target and the availability of land to develop.

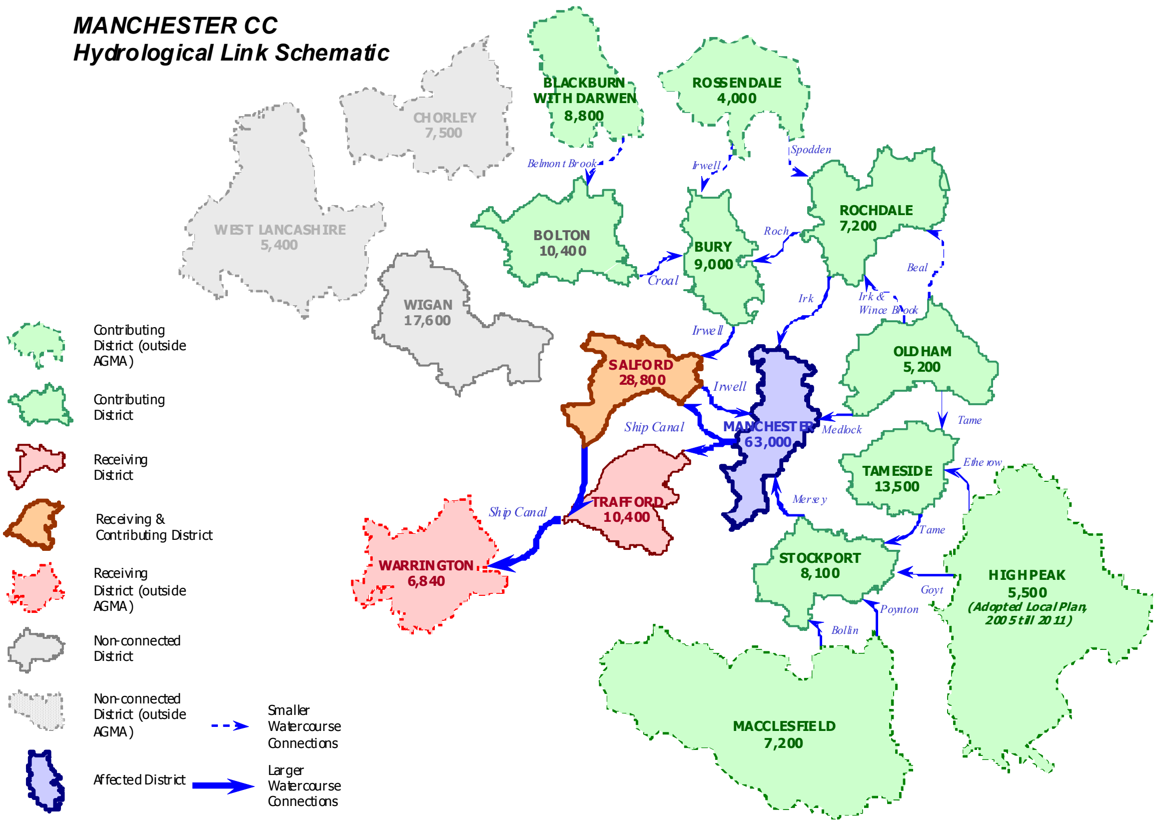


Figure 3-3: Hydrological Links

3.3.2. Potential Conflicts between broad development aspirations and the PPS25 Sequential Test

As highlighted above, the main flood risk to the district is primarily from fluvial sources, in particular the River Mersey. Whilst on a smaller and more localised scale, significant and more frequent flooding problems have also been identified as a result of sewer and drainage issues. In addition, there is, at present, an unquantified risk of flooding from the Manchester Ship Canal, the Bridgewater Canal and the Rochdale Canal. Although limited records of flooding are known to have occurred on the Bridgewater Canal and the Rochdale Canal there is an inherent potential flood risk from the canals and therefore a potential conflict with the PPS25 sequential test.

The floodplain of the River Irk and the Medlock could affect development within the City Centre, the Regional Centre and the Manchester Inner Area including the University, Brunswick, Hulme and Harpurhey. Similarly, fluvial flood risk from Chorlton Brook affects the southern extent of the Manchester Inner Area, in particular, Chorlton-cum-Hardy, Fallowfield and Withington.

In addition, the RSS has identified a target of 90% of new development to occur on PDL and outside the large areas of open space within the district. Therefore, with the shear scale of development proposed for Manchester CC, there is potential for an increase in the amount of impermeable area and the subsequent increases in runoff and the impacts on surface water and sewer flooding. Using UU data and the Urban Morphology Types (UMT) boundaries from the ASSCUE project the percentage of impermeable areas within the district can be identified and it is recommended that the risks associated with potential surface water (pluvial) and sewer flooding in these areas is examined in more detail at the Level 2 stage.

In order to examine these potential conflicts in more detail, it will be necessary to create higher resolution and smaller scale maps showing more detailed flood outlines, taking into account functional floodplain and climate change (as per PPS25 requirements) and displaying the risk associated with the MSC during the Level 2 SFRA.

3.3.3. Impacts on and from other strategic spatial considerations

Other spatial considerations that Manchester should take account with regards to flood risk include the Greater Manchester Green Infrastructure Scoping Study 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 that the River Mersey corridor through the District is already relatively free of buildings and impermeable areas. This area already includes the Didsbury Flood Storage Area. However, the amount of built up and impermeable areas along the majority of the Irk, Medlock, Baguley and Chorlton Brook corridors through the City Council is significant and there are few opportunities to provide additional flood storage. However, it is nonetheless important that opportunities are sought to identify areas of floodplain or wetland reinstatement, even small areas, in conjunction with the Green Infrastructure Study that may not only have flood risk benefits, but also ecological and environmental improvements.

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.

Manchester CC is also undertaking the Manchester Waterways Strategy. The strategy aims to examine the existing and future role of waterways and how they can tie in with future development and change in Manchester. The strategy also examined the importance of developing the waterway corridors in Manchester and how important they are as a focus for regeneration, providing a vital link with the industrial heritage of the City. The strategy has been used to inform the Strategic Overview of Flood Risk section as it highlights potential development and flood risk conflicts.

Waste and hazardous substances can also be released by flooding and potentially introduce harmful and polluting substances into flood waters for transport and distribution elsewhere. The Greater Manchester Waste DPD is currently being undertaken and identifies current and future areas for waste management, storage and transfer. Using this in conjunction with the SFRA may help to reduce the risk of flooding to waste sites. The SFRA should also be used to identify mitigation options for current waste sites within the region so that existing risks of contaminant release can be reduced.

3.3.4. Strategic Effects of Defence failure

As highlighted above, the main watercourses within the District already have extensive raised flood defences. In particular, there are extensive flood defence and control structures along the River Mersey. The failure of the Mersey Flood Alleviation scheme to operate correctly may also adversely impact on areas within Trafford. For example, if the Didsbury FSA in Manchester and the Sale Water Park are not operated correctly or fail, there is a potential for increased flood risk downstream.

Raised defences exist along the Medlock, Irk and Chorlton Brook though these are very heavily urbanised channels and, as such, the defences tend to consist of a mixture of formal (purpose built), informal (performing a flood defence role though designed to) and private structures. In addition, the channels tend to heavily engineered and are often very deep. Extensive reaches of culverted watercourse (~19.5km) exist within Manchester CC, which is also reflection of the heavy urbanisation within the council. As a result, areas adjacent to these watercourses may be more at risk of flooding as a result of channel blockages, culvert collapses and structure failures.

3.3.5. Identifiable strategic mitigation options

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. Similarly, locating storage facilities too low in the catchment may also have limited benefits and be difficult to locate due to the lack of suitable locations (in terms of topography, urban extent and available land). 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

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 Tameside and Stockport. However, 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 Stockport, they provide benefits to all districts downstream. Due to the relatively limited scale of flooding from the Irk, Medlock and Chorlton in Manchester, strategic mitigation measures were not considered in the Irwell Pilot CFMP. As a result, the most strategic mitigation measures are to limit the volume and slow the rate of water entering the watercourses as a direct result of runoff and drainage discharge. In reality this is a very challenging task, as there are numerous outfalls and discharges into these urban watercourses. However, as new development occurs, the strict use of SuDS over broad development areas can help to reduce runoff and subsequent discharges to the watercourses. The implementation of common policies on SuDS throughout the AGMA 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 Salford, Manchester and Trafford, infiltration SuDS are likely to be most suitable for new development, however the risk of contaminating the underlying aquifers needs to be seriously considered.

To meet the costs of catchment and AGMA wide flood risk management options, it may be necessary for the council to implement a local tariff-based system into the local development plan process. This would allow funds to be raised from new developments that fall into potential flood risk areas. The system could also be run in conjunction with other AGMA councils 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 land use planning and the gradual reinstatement of green open spaces together with wetlands and woodlands throughout the catchment will help to reduce runoff, identify and restore or create floodplain which further reduce flood risk across catchments.

Manchester_Overview/01

Manchester_Overview/02

Manchester_Overview/03

4. Oldham Metropolitan Borough Council

4.1. Oldham Development and Planning Context

Oldham Metropolitan Borough is situated in the northeast of the Greater Manchester conurbation, 9.5 km from Manchester City Centre. It covers an area of approximately 14,235 ha. The District consists of the urban areas of Chadderton, Crompton, Failsworth, Hollinwood, Lees, Oldham, Royton and Shaw, together with the settlements of Delph, Denshaw, Diggle, Dobcross, Grasscroft, Greenfield and Uppermill in Saddleworth. Around half the District is open land, including the southeast corner of the District, which falls within the Peak District National Park. The District has a population of 219,000 (mid-2005 estimate) with approximately 90,000 households (2001 census). A map presenting planning information for Oldham is included at the end of this section (Figure Oldham Overview/02).

The District is undergoing wide ranging and comprehensive regeneration based around transforming the local economy and housing market. A key element of this is the HMR Pathfinder initiative, which seeks to transform low demand housing markets. Regeneration activities to stimulate and improve the District's economic performance and prospects are also central to its transformation. Part of this regeneration will be based around attracting new, high quality investments to the District. Regeneration initiatives seek to transform all parts of the District, particularly the urban parts and a series of master plans have been, or are in the process of being, prepared to take forward the District's regeneration.

4.1.1. Strategic and Regional Position

Oldham MBC is one of the Authorities that make up the Pennine part of the Manchester City Region in the draft RSS and therefore relates to the other Authorities in this grouping, particularly neighbouring Rochdale and Tameside. Oldham also forms a gateway to the Pennines and to West Yorkshire. As such, Oldham also relates closely with Kirklees District Council across the border into Yorkshire. Within the draft RSS, Oldham is not highlighted as a location for any key regionally strategic sites but contains part of the Oldham-Rochdale HMR Pathfinder area.

4.1.2. Local Development Framework

Timetable

Oldham's Local Development Scheme (LDS) sets out the timetable for the development of their Local Development Framework (LDF). The Core Spatial Strategy is currently at the Issues & Options stage and an Issues & Options Report has been prepared. The Site Allocations DPD is at an early stage in the preparation process. All the Greater Manchester Authorities are preparing a Joint Waste DPD, which will be at the 2nd stage Issues & Options Paper in January 2008. The Oldham LDS sets out 8 Supplementary Planning Documents (SPDs), four of which have been adopted, three will be adopted in early 2008 and the remaining one will be adopted by the end of 2008. The entire Oldham UDP has been saved as statutory planning policy for Oldham until the end of 2009 to allow time for the new LDF to be prepared.

Oldham MBC is presently consulting on the Issues & Options Report of the Core Strategy. Oldham has identified three over-arching spatial strategy options for the Core Strategy:

Option A: Focused Regeneration – the focus for new development would be on regeneration areas, including Oldham Town Centre and the District Centres, at strategic locations such as Hollinwood and at major public transport nodes and along corridors such as Metrolink stops, i.e. developments would be targeted on the most accessible and sustainable locations.

Option B: Urban Concentration – most development would be within the existing built-up areas of the District, which includes the Saddleworth villages, thus following the same basis as the adopted UDP.

Option C: Urban Concentration including planned expansion – this option would be similar to Option B but would also see the targeted expansions of the existing built up areas to release land for new developments.

Regeneration Activity

As already mentioned, one of the key regeneration initiatives in Oldham at the moment is the Oldham-Rochdale Housing Market Renewal (HMR) Pathfinder. In Oldham, this activity is focused on the areas of Werneth / Freehold, Hathershaw / Fitton Hill, Derker, Alt, Sholver and the estates of Clarkwell, Crossley and Primrose Bank. In addition to this, the Hathershaw / Fitton Hill area also has a New Deal for Communities (NDC) team with in excess of £50 million grant assistance, although this programme is nearing the end of its six years. Oldham, as an Authority have also received nearly £30 million in Neighbourhood Renewal Fund allocations since 2001, funding which is to be used to narrow the gap between deprived areas / communities and the rest of society.

Oldham, like many of the Greater Manchester Authorities, has an industrial heritage which is at one and the same time of great value but can also be a hindrance to social and economic development. As such, Oldham MBC have a regeneration vision for District as a whole that in turn has led to regeneration activity in various key nodes across the District, including Oldham Town Centre, District Centres, key gateways and key employment / retail / leisure areas. This activity, together with the programmes outlined above, are seeing Oldham make use of its industrial heritage to create sustainable communities and modern business developments to enable Oldham to continue to develop as an attractive place to live and work.

Housing Land

An earlier target set by the Regional Planning Guidance for the North West (RPG 13) indicated an annual requirement for 270 dwellings to be constructed in the District, net of clearance replacement. However, the replacement draft Regional Spatial Strategy specifies that 400 dwellings should be provided per annum. The Panel Review of the draft RSS recommended that this figure be revised down to 289.

Table 4-1 Regional Spatial Strategy Targets: 2003 – 2021

	Draft RSS Target	Panel Review Recommended Target
Overall Housing Increase 2003-21	7,200	5,200
Mean Annual Increase	400	289
Indicative Previously Developed Land	80%	80%

The Housing Supply Trajectories can be drawn from the Chart below (AMR 2006, p.24) which shows net completions by financial year to 2005/06 and projected net completions until the year 2015/16. The Chart also shows the variance of historic net completions from the adopted RPG annual requirement of 270 dwellings (net clearance redevelopment) and the projected variance from the RPG requirement and from the Draft RSS requirement of 400 dwellings (net clearance redevelopment).

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Actual Net Build	273	323	270	135	132										
Net Build (projected)						180	180	280	280	280	280	280	400	400	400
Annualised net supply						377	377	377	377	377	377	377	377	377	377
Variance from current RSS (historic)	3	53	0	-135	-138										
Variance from current RSS (projected)						-90	-90	10	10	10	10	10	130	130	130
Variance from Draft RSS (projected)						-220	-220	-120	-120	-120	-120	-120	0	0	0

Figure 4-1: Housing Trajectory

As can be seen, in general, recent years have seen an overall under-supply of housing in comparison to the RPG target. In addition, given that the requirement that the RSS will ultimately settle on will be for the period 2003-2021, even if it adopts the Panel Review recommendation, in the years 2003-2006 Oldham will have not met the 289 dwellings target once and this is projected to continue until 2013.

For the period 2003-2016, the above chart projects that virtually 3,500 will be built. This means that a further 1,700 dwellings will need to be built between 2016 and 2021 in order to meet the Panel Review recommended target (if this were to be adopted) and a further 3,700 dwellings will need to be built if the Draft RSS target were to be adopted. This equates to 340 dwellings per annum or 740 dwellings per annum respectively for the years 2016-2021.

Ultimately, what this means is that, if Oldham is to meet the expected regional target of 5,200 dwellings (net clearance redevelopment) between 2003 and 2021, a large proportion of the target will need to be met in the latter part of this period and a large supply of housing land will need to be identified. This will be even greater if the current Draft RSS target of 7,200 is adopted.

Clearly, depending on which option the District choose to follow for the Core Spatial Strategy, identifying this supply of land may be difficult but, given that there is a significant level of regeneration activity within the District, it is possible that much of the housing requirement will be met through the Housing Market Renewal and through the master plans being prepared for the regeneration of the town centre and various other parts of the District.

These broad locations and the distribution can be seen to reflect a combination of Options 1, 2 and 3 with regards the Core Strategy's Spatial Options as the locations are centred on existing centres and regeneration areas in a band between Bury Town Centre and Radcliffe with smaller scale developments in the Ramsbottom, Tottington, Whitefield and Prestwich.

Employment Land

The Core Strategy Issues & Options Report states that:

> "At 2006 there was 92 hectares of land allocated for business and industrial uses across the District. Of this, however, only 37 hectares are considered to be of a sufficient quality to be attractive for potential investors. At recent rates of development this represents less than a five-year supply of quality employment land. Recent distribution of industrial development has been skewed towards the western part of the District with its perceived locational advantages linked to the motorway network." (p.29)

However, a further complication is that there is pressure to use some of this land for other uses, particularly housing, further reducing an already short supply of employment land. This, coupled with a general shortage of developable land in the District, may result in Oldham becoming reliant on neighbouring Authorities for employment and becoming more of a commuter town, which will have transport and access implications.

In the financial year 2005/06 a total of 24,502 m² of B1, B2 and B8 floor space was developed on 7.1 ha of previously developed land within the regeneration priority areas (AMR 2006, p.20-21). This represents all the development of employment uses within the District for that year. The total amount of employment land available for industrial commercial use on sites over 0.4 ha in size is 91.66 ha (AMR 2006, p.21). However, this sum includes 10 ha allocated for mixed-use development, where only a portion is expected to be use for commercial industrial.

Transport Infrastructure

Oldham is well-served by some forms of public transport, particularly to Manchester City Centre, and the proposed metrolink extension will improve this. In terms of strategic road corridors, Oldham has access to the rest of Greater Manchester and the Northwest via the M60, to the neighbouring Authorities of Manchester, Rochdale and Tameside via key A-roads, to West Yorkshire via the M62 and the A62 (Huddersfield Road) and to the Peak District National Park via the A669 / A635. Within Oldham, the road network is better in the south and west of the District but key corridors out from the town centre to the north and east provide good road access to the settlements in those parts of the District.

In terms of public transport, Oldham has good bus connections to Manchester City Centre from the majority of the District and (usually via the town centre) to neighbouring Authorities in the northern part of Greater Manchester. Various parts of Oldham also have rail connections to Manchester and Rochdale and via these to the wider UK. However, this is due to be improved by the planned extension to the metrolink network.

Within the District public transport is generally good with bus services focused on the town centre. According to the AMR (2006) virtually all parts of the District except the most rural parts in the north and east are within 30 minutes on public transport to a GP / health centre, hospital, employment areas, primary and secondary schools and town or district retail centres.

4.2. Oldham Flood Risk Summary

4.2.1. Hydrological background: catchment and watercourse network

The District of Oldham lies within the Greater Manchester SFRA area. The District is situated in the upper catchments of the Rivers Irk, Medlock and Tame. Other watercourses within the District include the River Beal, Hull Brook, Lords Brook and Wood Brook. All of these watercourses carry with them an inherent potential flood risk. The middle reaches have flatter and lower topography than the upper catchment and flooding can be spread over a larger area than in the steeper and more confined floodplains of the upper catchment. The main urban areas at greatest risk from flooding in the District are Oldham, Shaw, Failsworth, Royton and Uppermill. The River Irwell CFMP and draft Upper Mersey CFMP cover the District and provide a catchment wide assessment of flood risk, and can be used as a tool to aid planners strive towards sustainable development. Table 4-2 shows the main watercourses and urban areas at risk of flooding from each. A map presenting flood risk information for Oldham is included at the end of this section (Figure Oldham Overview/01).

Table 4-2: Watercourse and Urban Area at Risk in Oldham

Main Watercourses	Urban area at risk
Beal	Shaw
Irk	Oldham, Failsworth
Medlock	Failsworth
Tame	Oldham, Delph

4.2.2. Historical Flooding

A review of the information supplied by the council, the EA, CFMP's, and through searching online historical records[22,] has revealed that Oldham has experienced a number of flood events throughout the last century. Historically the District has experienced river flooding predominantly from the Tame, Beal Irk and Medlock, and surface water and sewer flooding from localised intense rainfall events. The historic records of flooding show that the District is vulnerable to both periods of prolonged rainfall in the autumn and winter months mainly leading to fluvial flooding, and local flash flooding primarily of surface water caused by intense summer downpours. Table 4-3 shows a number of significant historical flood events.

British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe [22]

Table 4-3: Significant Historic Flood Events in Oldham

Date	Location	Source of flooding	Impact	Source of information
1964	River Beal, Shaw	Fluvial	350 properties flooded	Irwell CFMP
December 1965	River Tame	Fluvial/sewer flooding	Livestock killed, flooded property and evacuations Sewers burst	BHS Database
December 1992	River Beal	Fluvial/sewer flooding	Land, properties and sewers flooded	Oldham MBC
December 1992	Uppermill, Tame	Fluvial	Flooded land, properties and car parks	Oldham MBC
November 2000	Tame/Hull Brook at Delph	Fluvial	Flooded Elderly Persons Home	Oldham MBC
July 2002	Oldham, Medlock	Fluvial/surface water	Properties, highways and land flooded	Oldham MBC
August 2004	Royton, Irk	Fluvial/surface water	Homes flooded	Oldham MBC
2006	Grotton Hollow, Wood Brook	Fluvial/surface water	Localised flooding	Comments from EA

4.2.3. CFMP Assessment of Flood Risk

The District is covered by the draft Upper Mersey CFMP and the River Irwell CFMP. CFMP's have split overall flood risk in the District into the seven units displayed in Table 4-4. The CFMPs have assessed the level of flood risk in each of the policy units defined within them, as being high, medium or low, and this is also displayed in Table 4-4. Draft policies are subject to change and the SFRA must be adapted accordingly. The CFMPs have also recommended a preferred policy option number for each unit. The generic policy options are shown in Table 4-5.

Table 4-4: Policy units and preferred policy for Oldham

Policy Unit	Policy Option	CFMP	Risk
12:South Oldham to Droylsden (Medlock)	6	River Irwell	Low
13:Middleton and Chadderton (Irk)	5	River Irwell	High
14:North Oldham (Irk)	4	River Irwell	Low/Medium
19: Whitworth, Shaw and Milnrow (Roch)	5	River Irwell	High
20.Rural Roch	6	River Irwell	Low
PU1 Peak District	3	Upper Mersey	Low
PU3 Tame	5	Upper Mersey	High

Table 4-5: Generic CFMP policies

Policy 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)

4.2.4. Current and Future Flood Risk in Oldham MBC

Identification of Flood sources

Flooding from Rivers

The historic flood event search, the EA, the District Council, and the CFMP all suggest that the main flood risk within the District is flooding from rivers, though the scale of risk is smaller than other councils in the AGMA sub-region. Upper reaches of rivers are susceptible to short-term intense rainfall events such as thunderstorm activity where large volumes of water are confined to relatively narrow river valleys. Areas surrounding confluences of tributaries and main channels such as the confluence of Lords Brook and Medlock south of Failsworth, and on Wood Brook at Grotton, have an increased flood risk, particularly if flood peaks on both watercourses coincide or flow exceeds culvert capacity. As Oldham is heavily urbanised area in places, many watercourses are culverted in sections and so flooding due to flow restrictions, which can be attributed to sedimentation and blockage of structures and weirs, is a risk, and a known problem in Chadderton. This type of flooding is primarily found upstream of structures when water backs up behind the blockage and ultimately overtops the channel.

Whilst fluvial flooding poses a significant risk to the District 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.

Flooding from the Land

During periods of prolonged rainfall events and sudden intense downpours, overland flow from adjacent higher ground may ‘pond’ in low-lying areas of land without draining into watercourses, surface water drainage systems or the ground. 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.

Flooding from Sewers

Sewer flooding is another flood risk throughout the District, particularly during severe rainfall events, where the design capacity of the sewer network is insufficient to cope with the high volumes of water. This is a known issue in Oldham. During periods of high river flow, there is the potential for such drainage systems to become ‘tide locked’ and unable to discharge to the watercourse. The water then backs up and will again start to discharge. Sewer flooding was identified using historical records from United Utilities DG5 database (June 2007) detailing the total number of flood events that affected both internal and external property.

It should be noted that much of the sewer network is thought to date 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 the WRC "Sewers for Adoption"[23] 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 this design standard is not achieved. It is therefore likely that much 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.

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) (Figure 4-2) 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 that is also covered by the Data Protection Act (1998). According to the data, Oldham MBC has one of the lowest internal recorded sewer flooding incidents (17) in the AGMA sub-region. However, DG5 data is a "snapshot" in time and may therefore have missed a significant rainfall event. As a result, a detailed analysis of the scale and consequences of sewer flooding has not been possible at this stage of the SFRA.

However, during the course of this study, 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 and AGMA have agreed to share data on drainage and development areas initially for Bury and Salford. This will allow both UU and AGMA to determine the usefulness of the data and to agree how it can be spatially represented on a sub-regional and strategic basis for the whole of the AGMA area. It is anticipated that both UU and AGMA will have agreed the scale and format of the data in time for Level 2 SFRAs.

Flooding from Reservoirs, Canals and Other Artificial Sources

There are a number of reservoirs in and upstream of the District such as the New Years Bridge and Dowry Reservoirs. Reservoirs have an attenuating effect on flood flows and can potentially be used to control flows. Reservoirs do however have a flood risk associated with them in terms of dam/reservoir wall failure and emergency releases into the catchment. The likelihood of this occurring is minimal but impacts are potentially extremely high due to the limited warning time available and the potentially high velocity and high volume flows.

The Rochdale Canal and the Huddersfield Narrow Canal run through the District. 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 remains where water levels could overtop or breach embanked sections.

[23] Sewers for Adoption, Wrc Publications 2006

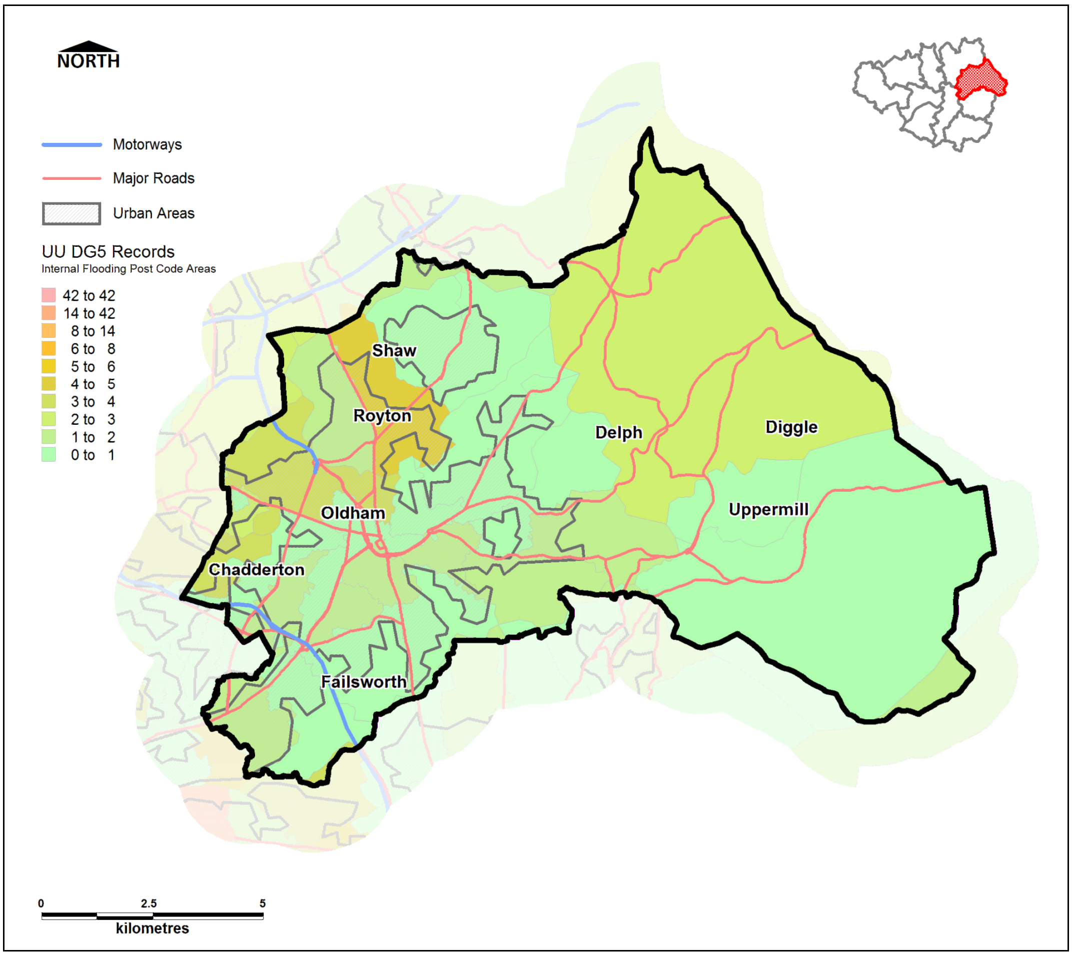


Figure 4-2: Oldham UU DG5 data (June 2007) showing instances of Internal Flooding by five-digit postcode area.

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 have revealed no reported incidents of groundwater flooding in the District.

British Geological Survey (BGS) Maps show the area to be underlain primarily by mudstone, siltstone and sandstone. As a result, the EAs groundwater vulnerability maps show that much of the District is classified as minor aquifer with approximately half being of lower permeability and half being of higher permeability. Superficial deposits in Oldham consist primarily of peat and glacial till with some sand and gravel deposits along the northern boundary.

The impacts of increased development in these areas must therefore be carefully assessed. For example, larger infiltration based SuDS methods may less suitable in the glacial tills (with a high, less permeable clay content) and may actually increase groundwater levels locally. As a result, small scale soakaways or attenuation schemes may be a more suitable SuDS method through much of Oldham MBC. In addition, deep excavations for new development (for example, underground car parks and basements, or new infrastructure tunnels) should be carefully assessed to determine what risk is posed.

Fluvial Flood Zones

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 and each outline used to create the SFRA flood zones assumes that no defences exist. There are no areas of tidal flood risk within the AGMA sub-region.

However, there are areas where little or no accurate flood outlines exist, and therefore, to ensure a continuous coverage across a flood zone, less accurate, broad-scale modelled (the EA J-FLOW Flood Zones) outlines were used instead. This hybrid approach provides a conservative flood zone and highlights potential uncertainties that can either be resolved in more detail at Level 2, or by developers as part of site-specific FRAs. The SFRA has identified the following flood zones in accordance with PPS25:

Flood Zone 1: Low Probability of Flooding
Land having a less than 1 in 1000 annual probability of river 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%) in any year. However, for the rest of Oldham MBC, no detailed modelled outlines exist for Flood Zone 2 and therefore, the EA broad-scale Flood Zone 2 maps were used.

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

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. Where possible, 1:20 or 1:25 year detailed modelled outlines were used to define the functional floodplain. Some defended areas may include flood storage basins which are by their very nature functional floodplain. 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 in the data and potential tasks for the more detailed Level 2 assessments. 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.

Using the Flood Zone maps, the total area of Oldham at risk of fluvial flooding can be determined. Table 4-6 and Figure A-5 (Appendix A) show that comparatively few areas of the District are at risk of fluvial flooding with approximately 2.4% of the council area affected by Flood Zones 2 and 3.

Table 4-6: Area of Fluvial Flood Risk to Oldham MBC

District Area (ha)	Urban Area (ha)	Fluvial Flood Zone	Area (ha)	% (of District or Urban Area)
14,189.00[24]	3,506.16	FZ3b	180.71	1.27
		FZ3a	69.01	0.49
		FZ3 in Urban	31.98	0.91
		FZ3 + CC	48.95	0.34
		FZ2	88.01	0.62
		FZ2 in Urban	14.53	0.41

Note: Figures for FZ3a refer to the area outside of FZ3b, figures for FZ3+CC and FZ2 refer to the area outside of FZ3a.

Flood Zone Confidence

Flood Zone Confidence Maps are intended to be used by planners as a tool for identifying areas of high, medium or low confidence in the data that has been used to derive fluvial Flood Zones across the sub-region. The confidence assigned to a Flood Zone demonstrates the level of detail and the number of assumptions made when deriving the Flood Zones.

[24] Figure includes an area in the south east of the Borough which is the planning responsibility of the Peak District National Park

Table 4-7 illustrates the confidence assigned to the Flood Zones present within the Oldham MBC district. A map showing confidence in the each of the Flood Zones is presented at the end of this section (Figure Oldham Overview/03).

Table 4-7: Fluvial Flood Risk Confidence for Oldham MBC

District	Fluvial Flood Zone	Watercourse	Settlement	Source	Date of Modelling Study	Confidence
Oldham	3b	River Tame	NA	Upper Mersey S105 Model	2001 (May 2008)	Low
		All Other Watercourses	Uppermill Oldham	EA Flood Zone Maps	NA (May 2008)	Low
		River Irk, Moston Brook	Chadderton Failsworth	Irk FRM Model	2003 (May 2008)	High
		River Beal	Shaw	Roch Tributaries Model	2006 (May 2008)	High
		Chew Brook	NA	Tame NFCDD Chew	2008 (May 2008)	High
		Diggle Brook	Diggle	Tame NFCDD Diggle	2008 (May 2008)	High
		River Tame	Uppermill	Tame NFCDD Tame 06	2008 (May 2008)	High
	3a	All Other Watercourses	Shaw Oldham	EA Flood Zone Maps	NA	Medium
		River Tame	NA	Upper Mersey S105 Model	2001	High
		River Beal	Shaw	Rochdale Tributaries (Draft)	2006	High
		Chew Brook	NA	Tame NFCDD: Chew	2008	High
		Diggle Brook	Diggle	Tame NFCDD: Diggle	2008	High
		River Irwell	Chadderton Royton	Irwell ABD (Draft)	2008	High
		River Tame	Uppermill	Tame NFCDD: Tame 06	2008	High
	3a +CC	River Beal	Shaw	Roch Tributary Model (DRAFT)	2006	Low
		Diggle Brook	Diggle	Tame NFCDD: Diggle	2008	High
		Chew Brook	NA	Tame NFCDD: Chew	2008	High
		All Other Watercourses	Uppermill Oldham	EA Flood Zone Maps - Flood Zone 2	NA	Low
		River Tame	Uppermill	Tame NFCDD: Tame 06	2008	High
		River Irk, Moston Brook	Chadderton Failsworth	Irk FRM	2003	High
	2	All Other Watercourses	Shaw Oldham	EA Flood Zone Maps	NA	Medium
		River Irwell	Chadderton Royton	Irwell ABD (Draft)	2008	High

Climate Change and Future Flood Risk

The CFMP's have 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 District. Defra/UKCIP (United Kingdom Climate Impacts Programme) 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

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) programme examined surface water runoff during extreme rainfall events in the Manchester sub-region. With an increase in development, there comes an increase in the amount of impermeable areas thus leading to increased runoff during storm events. In one of the worst-case modelled scenarios, an increase in rainfall of 56% by 2080, led to an increase in runoff of 82%. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

The location of future urban developments and flood defences within a catchment can influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments. It may however be possible to mitigate against this 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.

To account for Climate Change at the sub-regional level, 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 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 Level 2 stage or during site-specific FRAs (developer-led).

Flood Risk Mitigation and Management

Flood Risk Management

Flood risk management assets may be hard formal structures designed for purpose such as flood walls, or they may be informal structures such as garden walls which were not designed specifically as defence structures, but are now performing that role. The National Flood and Coastal Defence Database (NFCDD) identifies any asset (including channels) that may have an impact on flood risk management and is constantly being updated and amended by the EA as a result of ongoing asset inspections. It should be noted that the database assigns a Standard of Protection (SoP) to flood defence assets and has a default value of 50 Years. Therefore the SoP values should be treated with caution and assessed (in conjunction with the EA) on a site-by-site basis during the more detailed Level 2 SFRA. NFCDD data, along with CFMP's and council supplied information, have been used to identify the following major structures and flood defences assets in the District.

Reservoirs: Delph Reservoir
Dovestone Reservoir
Castleshaw Moor

Flood Defences: Uppermill, Shaw, Diggle, Denshaw

By interrogating NFCDD outputs, a series of informative statistics about flood risk assets can be obtained. For Oldham MBC, data from NFCDD shows that there are over 11km of culverted watercourses and 7km of man made raised flood defences, 5.6km of which have a SoP of between 21 and 50 years (Table 4-8).

Table 4-8: NFCDD data summarising lengths of flood defence asset in the Oldham MBC Area (km) by Standard of Protection (return period in years).

Asset Type	Length of FRM Asset (km) by Standard of Protection in years					
	Unclassified	0-20	21-50	51-75	76-100	Total
Culverted Channel	0	0.23	10.87	0.58	0.02	11.70
Maintained Channel	0	0.01	0.07	0.00	0.00	0.08
Natural Channel	0	3.43	26.04	5.00	0.00	34.47
Flood Defence Structure	0	2.74	51.45	1.05	0.24	55.48
Non-Flood Defence Structure	0	0.06	0.36	0.14	0.00	0.56
Raised Defence (Man-Made)	0	0.39	5.61	1.19	0.00	7.19
Total	**0**	**6.87**	**94.39**	**7.95**	**0.26**	**109.48**

Mitigation

There are many different types of flood risk mitigation actions ranging from small, single dwelling flood proofing measures to flood warning services to large multi-million pound flood defence schemes.

Flood warning areas have been an effective mitigation measure for many years. However, flood warnings tend to work most effectively during large events with long lead times so that sufficient advance notice is given to residents and businesses and are usually only applicable to fluvial flooding. In the case of intense, flashy rainfall events, where pluvial and sewer flooding may pose the most risk, flood warnings schemes rarely exist.

Risk of Failure of Defences and Impacts

Behind defended areas there is a residual risk of 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 tend to be low lying, and the water level will have often built up to a higher level than ground levels of the defended area. The same risks can be associated with reservoir/dam failure, though the risk of such failures is considered to be minimal.

People and Property at risk of flooding

The EA carried out a strategic review of flood risk for the whole of the North West Region[25]. This looked at the EA Flood Zones and the number of properties at risk of flooding within each District in the North West. Table 4-9 shows the number of properties at risk of flooding in each flood zone.

Table 4-9: Properties at risk of flooding (source: EA Flood Zone Ranking using EA Flood Zones)

FZ3	FZ2&3	FZ1	Total
485	1,038	97,486	98,524

Using census Output Area (OA) data (the smallest census geographical area), and updated mid-term 2005 population estimates for Oldham, the potential populations affected by flooding in the different flood zones are presented in Table 4-10. 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 a district, 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 a OA by the type of accommodation they live in. Again, assuming an even distribution across a OA, an indication as to the predominant types of properties at risk can be shown.

Table 4-10: Approximate number of people affected by fluvial flooding in Oldham

	Population at Risk (2005)	People living in House Bungalow	People living in Flat or Apartment	People living in Caravans or moveable Accommodation	People living in Shared Dwelling
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

4.3. Strategic Overview of Flood Risk in Oldham MBC

4.3.1. Consequences of Upstream and Downstream Development

Broad development in Oldham as it relates to the River Beal, Medlock, Tame and Irk catchments is defined within the RSS in terms of housing figures. As Oldham is located in the upper levels of the catchments, it is at the top of the watershed and therefore there are no other councils that hydrologically upstream. However, there is potential for development in Oldham to affect flood risk in councils downstream that are hydrologically connected (either directly or indirectly). The main potential adverse impacts that future development may have on downstream areas is twofold:

[25] 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)

Reduction in Floodplain: Unrestricted development in floodplains can reduce the natural flood storage capacity of a river and, consequently, convey more water downstream.

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.

Should RSS targets be met, a total of 146,840 new homes are proposed in the 8 councils located downstream – Salford CC, Manchester CC, Trafford MBC, Rochdale MBC, Stockport MBC, Tameside MBC, Bury MBC and Warrington MBC (Figure 4-3). These figures are for net new housing and so are additional to the current levels of development. Within the draft RSS, Oldham is not highlighted as a location for any key regionally strategic sites but contains part of the Oldham-Rochdale HMR Pathfinder area. Likely development areas within Oldham are upstream of the Manchester, Salford and Trafford Inner Areas, the Regional Centre and the Manchester City Centre where substantial development ambitions and pressures exist.

To avoid reducing floodplain storage and potentially increasing flood risk downstream, development within and adjacent to these areas must be undertaken carefully so as not to adversely affect flood storage or flood flow routes. In addition, the incorporation of green open spaces and SuDS measures may help to reduce increased runoff. In reality, however, it is likely that much of the new development will be constructed to modern and sustainable standards incorporating, where possible, SuDS to limit runoff.

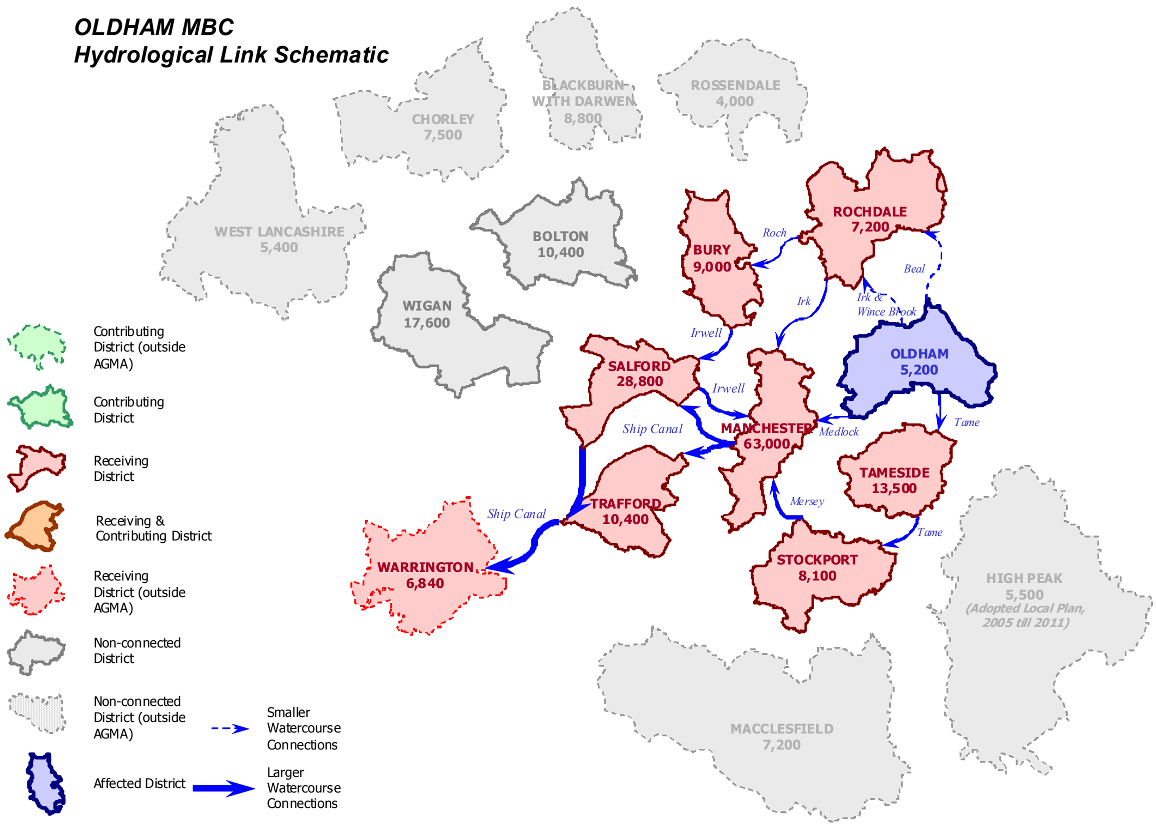


Figure 4-3: Hydrological Links for Oldham

4.3.2. Potential Conflicts between broad development aspirations and the PPS25 Sequential Test

As highlighted above, the current flood risk to the district is primarily from fluvial sources, in particular the River Roch, Beal, Tame, Medlock and Irk. In addition, there is, at present, an unquantified risk of flooding from The Rochdale Canal, and the Huddersfield Narrow Canal. Most of the potential development locations are concentrated in Oldham and are situated outside of the main flood zones, however, there are small areas of potential development that lie within flood zones 2 and 3.

Most of the proposed development areas are within densely populated areas in Oldham including extension of the Metrolink. Therefore, there is potential for an increase in the amount of impermeable area and the subsequent increases in runoff and the impacts on surface water and sewer flooding. Using UU data and the Urban Morphology Types (UMT) boundaries from the ASSCUE project the percentage of impermeable areas within the district can be identified and it is recommended that the risks associated with potential surface water (pluvial) and sewer flooding in these areas is examined in more detail at the Level 2 stage.

As a result, potential conflicts exist between development and the PPS25 Sequential Test in these areas. In order to examine these in more detail, it will be necessary to create maps showing more detailed flood outlines taking into account functional floodplain and climate change (as per PPS25 requirements) and displaying the risk associated with the Canals during Level 2 assessments.

4.3.3. Impacts on and from other strategic spatial considerations

Other spatial considerations that Oldham MBC should take account of with regards to flood risk include the Greater Manchester Green Infrastructure Scoping Study 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. 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.

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.

Waste and hazardous substances can also be affected by flooding and potentially introduce harmful and polluting substances into flood waters for transport and distribution elsewhere. The Greater Manchester Waste DPD is currently being undertaken and identifies current and future areas for waste management, storage and transfer. Using this in conjunction with the SFRA may help to reduce the risk of flooding to waste sites.

4.3.4. Strategic Effects of Defence failure

Impacts of defence failure include fast flowing, deep water which has the potential to cause major damage and loss of life within the District. At this time, it is not thought that the impacts of defence failure in Oldham will adversely impact on districts downstream.

4.3.5. Identifiable strategic mitigation options

Strategic options for mitigation include the upstream flood storage schemes. The River Irwell CFMP identifies that the creation of flood storage areas upstream in the catchment in the headwaters of the Beal which could potentially reduce levels by 0.3-0.4m in Rochdale.

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 catchment is reduced. Furthermore, and working closely with the outputs from the current sub-regional Green Infrastructure study, careful land use planning and the gradual reinstatement of green open spaces together with wetlands and woodlands throughout the catchment may help to further reduce runoff.

Oldham_Overview/01

Oldham_Overview/02

Oldham_Overview/03

5. Rochdale Metropolitan Borough Council

5.1. Rochdale Development and Planning Context

Rochdale Metropolitan Borough Council (RMBC) consists of six key centres located at Heywood, Littleborough, Middleton, Milnrow, Rochdale and Wardle. The District of Rochdale covers an area of 16,000 ha and is situated 16 km north of the City of Manchester, stretching from the northeast side of Manchester to the Pennines and the borders of West Yorkshire, and is bounded by the Trans-Pennine M62, the Manchester Orbital M60 and the M66.

The District has a population of 206,400, which is expected to increase to 217,250 by 2021. There are 85,000 households that is anticipated to increase to 99,000 over the same period. The population is diverse and situated predominantly within the main urban centres. Overall, the District suffers from significant levels of deprivation and 25% of 'small areas' in the District are amongst the most deprived in the country. Consequently, there is significant regeneration activity, notably the Housing Market Renewal Pathfinder Programme and New Deal for Communities. There is also the key development of Kingsway, which is recognised within the Regional Economic Strategy as being of regional significance. A map presenting planning information for Rochdale is included at the end of this section (Figure Rochdale Overview/02).

5.1.1. Strategic and Regional Position

Rochdale MBC is one of the Authorities that make up the Pennine part of the Manchester City Region in the draft RSS and therefore relates to the other Authorities in this grouping, particularly neighbouring Oldham, as well as neighbouring Bury, to the west. Rochdale also forms a key gateway into and out of Greater Manchester with the M62 passing along the southern edge of the District and the M66 along the western edge, making the District a gateway between Greater Manchester and West Yorkshire and East Lancashire. As such, Rochdale also relates closely with the West Yorkshire and East Lancashire Authorities, particularly neighbouring Calderdale and Rossendale. Within the draft RSS, southeast Rochdale is highlighted as a Regional Investment Site and contains part of the Oldham-Rochdale HMR Pathfinder area.

5.1.2. Local Development Framework

Timetable

Rochdale's Local Development Scheme (LDS) sets out the timetable for the development of their Local Development Framework (LDF). The Core Spatial Strategy is currently at the pre-production and participation stage, with the Issues & Options consultation expected to take place in early 2008, and the preparation of a Site Allocations DPD is due to commence in 2008. All the Greater Manchester Authorities are preparing a Joint Waste DPD, which will be at the 2nd stage Issues & Options Paper in January 2008. The Rochdale LDS sets out 10 Supplementary Planning

Documents (SPDs) and an Area Action Plan (AAP) for the Milkstone & Deeplish and Canal Basin area. The AAP's progress has been delayed due to the need to undertake a Regeneration Investment Strategy and so the timetable is under review. 3 of the SPDs have been adopted, 4 others will have been adopted by the end of this financial year and the remaining 3 will be adopted before the end of 2008. The Rochdale UDP was adopted in 2006 and has been saved as statutory planning policy for Rochdale until the LDF is complete, when it will be replaced by the LDF.

The District's strategic position on development is best summed up by Policy GP/S/1 in the UDP, which promotes urban regeneration by concentrating development within the urban area, and Policy GP/S/2, which restricts development in rural areas.

Regeneration

As already mentioned, one of the key regeneration initiatives in Rochdale at the moment is the Oldham-Rochdale Housing Market Renewal (HMR) Pathfinder. In Rochdale, this activity is focused on the areas of East Central Rochdale, Inner Rochdale (Milkstone, Deeplish and Newbold), Kirkholt and Langley in Middleton. In addition to this, Heywood has a New Deal for Communities (NDC) team with in excess of £50 million grant assistance, although this programme is nearing the end of its six years and Rochdale, as an Authority, have also received in excess of £30 million in Neighbourhood Renewal Fund allocations since 2001, funding which is to be used to narrow the gap between deprived areas / communities and the rest of society. Outside of these areas, Rochdale town centre and the Kingsway Business Park are also the focus of regeneration activity.

Housing Land

An earlier target set by the Regional Planning Guidance for the North West (RPG 13) indicated an annual requirement for 240 dwellings to be constructed in the District. Saved Policy H2/3 of the Unitary Development Plan makes provision for this annual increase over the period 2002-2016. However, the replacement draft Regional Spatial Strategy specifies that an additional 400 dwellings should be provided. The Council supports this number given the anticipated level of development schemes to come forward over the life of the plan period.

Table 5-1: RSS Target:

	Draft RSS Target
Overall Housing Increase 2003-21	7,200
Mean Annual Increase	400
Indicative Previously Developed Land	80%

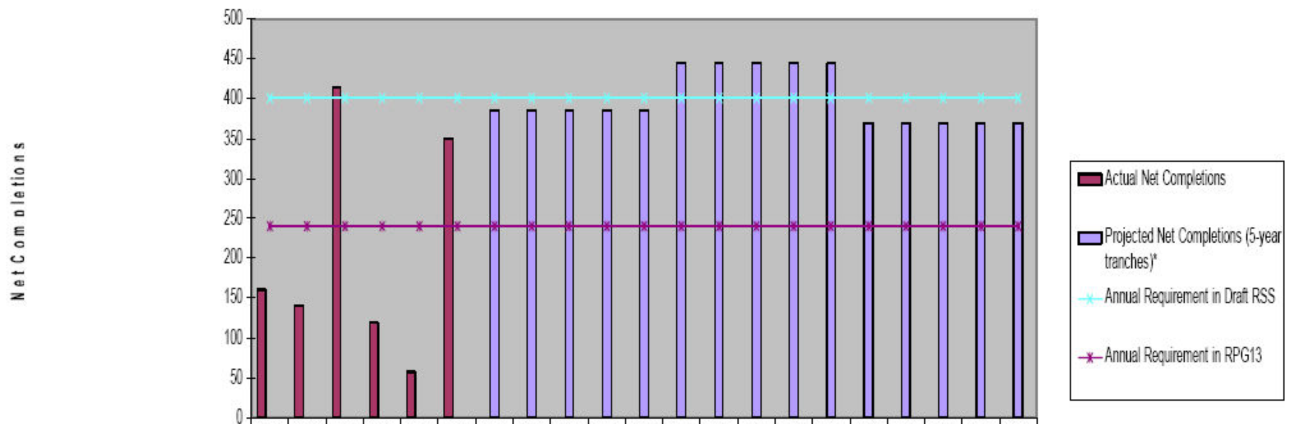
The Council can identify broadly where future housing supply will come from and when this is set against the RSS targets, it is likely that the targets will be met and exceeded. By and large, these are situated within developments that have already gained planning permission, and that are outside of the HMR neighbourhoods. The significant level of regeneration activity within the District will also contribute a significant proportion of the supply, particularly in the areas of HMR activity.

Table 5-2:: Housing Supply

Housing Land Supply	Units
HMR Neighbourhoods	2,892
Pipeline site outside the HMR Neighbourhoods	3,340
Residential Site within Kingsway development	300
Non-HMR UPS sites and sites with permission in April 2004	1,900
Total	**8,432**

Source: *Spatial Distribution of Future Housing in Rochdale Paper*

The Housing Supply Trajectories can be drawn from the Chart below (AMR 2006, p.24) which shows net completions by financial year to 2005/06 and projected net completions until the year 2020/21 and then overlays the current proposed annual housing requirement from RPG and the draft RSS (240 and 400 units respectively). The Chart (Figure 5-1) projects for 6,527 new dwellings (net clearance redevelopment) between 2003 and 2011 but it is clear from the Table above that there are other sites, as yet not included in the projections, which will allow the 7,200 dwelling target to be easily reached.



	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21
Actual Net Completions	160	141	415	119	58	350															
Projected Net Completions (5-year tranches)*							385	385	385	385	385	445	445	445	445	445	370	370	370	370	370
* Actual year on year projections assumed							325	350	375	425	450	475	475	450	425	400	400	375	375	350	350
Annual Requirement in Draft RSS	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
Annual Requirement in RPG13	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240

Figure 5-1: Rochdale Housing Trajectories

The UDP sets out that housing development should be focused in urban areas, particularly regeneration areas and the sources in Table 5-2 above fit with this policy.

Employment Land

There is potentially 178 ha of land available for employment development. This includes the Kingsway development, which constitutes a 100 ha site allocated on greenfield land and has outline planning permission for employment uses. The balance is located within existing employment sites, such as the District's business parks and other longstanding industrial areas. The Council has not achieved its targets of 10 ha per annum for completions of employment development. However, it is expected this annual output will increase over time as a result of development on the Kingsway site commencing.

Table 5-3: Employment land supply

Employment Land Supply	Quantity (ha)
Kingsway	100
Primary Employment Zone Sites	45
Mixed Employment Zone Sites	5.6
Sandbrook Park	3.1
Areas of Opportunity Sites	5
Unallocated sites in Employment Zones	17.1
Unallocated sites outside Employment Zones	1.8
Total	**177.6**

Source: *AMR (2006), p.20-21*

Transport Infrastructure

The strategic road network in Rochdale is reasonably good with the M62 travelling through the area, the M66 just to the west, the A58 traversing the District east-west and the A627(M) connecting Rochdale to Oldham. This means that Rochdale is well-connected by road to the neighbouring Authorities of Bury and Oldham, to West Yorkshire and East Lancashire and to the rest of Greater Manchester, the Northwest and the M6 corridor (via the M62).

However, alongside Bolton and Wigan, Rochdale is quite detached from the regional centre of Manchester in terms of direct road links, with the exception of Middleton, which is quite distinct from the rest of Rochdale and has closer spatial relationships to the areas of Manchester City and Oldham District to the south and east.

Public transport to the rest of Greater Manchester and the wider UK (via Manchester or Leeds) is mainly reliant on the train, although bus services are good to and from neighbouring Authorities. However, Rochdale town centre will benefit from the planned metrolink extension. This will create an excellent link to neighbouring Oldham and, via Oldham, to Manchester City Centre.

Within the District, the A58 and A664 roads form the main corridors for internal movement by road. Public transport within the District is centred on the town centre and involves the train (Manchester Victoria to Leeds route) or the bus. While the majority of the built-up area in Rochdale is within 30 minutes on public transport to a GP / health centre, employment areas, primary and secondary schools and town or district retail centres, this requirement to change bus/train in the town centre means that only a small proportion of the District is within 30 minutes on public transport of a hospital. This is partially due to the location of Rochdale Infirmary away from the town centre but also because Birch Hill hospital's provision and facilities have been significantly reduced.

Therefore, there is a need to improve public transport infrastructure to improve connectivity to services and facilities and a need to locate new development within locations that are accessible by public transport and sustainable modes of transport.

5.2. Rochdale Flood Risk Summary

5.2.1. Hydrological background: catchment and watercourse network

The District of Rochdale lies within the Greater Manchester SFRA area. The District is situated in the upper reaches of the Rivers Beal, Irk, Roch and Spodden. Other watercourses within the District include the Rochdale Canal, Naden Brook and Wince Brook along with numerous smaller watercourses. All of these watercourses carry with them an inherent potential flood risk. The upper reaches are susceptible to short-term intense rainfall events such as thunderstorm activity as water levels can build up in the steeper and more confined floodplains of the upper catchment. The main urban areas at greatest risk from flooding in the District are Rochdale, Shaw, Heywood, Middleton and Whitworth. The River Irwell CFMP covers the District and provides a catchment wide assessment of flood risk, and can be used as a tool to aid planners strive towards sustainable development. Table 5-4 shows the main watercourses and urban areas at risk of flooding from each. A map presenting flood risk information for Rochdale is included at the end of this section (Figure Rochdale Overview/01).

Table 5-4: Watercourse and Urban Area at Risk in Rochdale MBC

Main Watercourses	Urban area at risk
Spodden	Whitworth, Rochdale
Roch	Rochdale, Heywood
Beal	Rochdale
Irk	Middleton

5.2.2. Historical Flooding

A review of the information supplied by the council, the EA, CFMP's, and through searching online historical records[26], has revealed that Rochdale has experienced a number of flood events throughout the last century. Historically the District has experienced river flooding predominantly from the Roch and Irk and surface water and sewer flooding from localised intense rainfall events. The historic records of flooding show that the District is vulnerable to both periods of prolonged rainfall in the autumn and winter months mainly leading to fluvial flooding and local flash flooding primarily of surface water caused by intense summer downpours. Table 5-5 shows a number of significant historical flood events.

[26] British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe

Table 5-5: Significant Historic Flood Events in Rochdale MBC

Date	Location	Source of Flooding	Impact	Information Source
July 1927	Middleton, Irk	Fluvial and Rochdale canal overtopped	Localised flooding	BHS Database
1991	Roch, Rochdale	Fluvial	81 properties flooded	Irwell CFMP
1965	Roch, Rochdale	Fluvial	Localised flooding	Irwell CFMP
August 2004	Middleton, Irk	Fluvial	Homes flooded	Manchester Evening News
August 2004,	Heywood	Surface water flooding	Localised flooding	Manchester Evening News
July 2006	Heywood	Surface water flooding	Localised flooding	Manchester Evening News

5.2.3. CFMP Assessment of Flood Risk

The District is covered by the River Irwell CFMP. CFMP's have split overall flood risk in the District into the eight units displayed in Table 5-6. The CFMPs have assessed the level of flood risk in each of the policy units defined within them, as being high, medium or low, and this is also displayed in Table 5-6. The CFMPs have also recommended a preferred policy option number for each unit. The generic policy options are shown in Table 5-7.

Table 5-6: Policy units and preferred policy for Rochdale MBC

Policy Unit	Policy Option	CFMP	Risk
8. Rossendale valley (Irwell)	5	Irwell	Medium
9. Rural Rossendale (Irwell)	6	Irwell	Low
13: Middleton and Chadderton (Irk)	5	Irwell	High
14: North Oldham (Irk)	4	Irwell	Low/Medium
17: Heywood and Whitefield (Roch)	3	Irwell	Medium/High
18: Rochdale and Littleborough (Roch)	4	Irwell	Medium/Low
19: Whitworth, Shaw and Milnrow (Roch)	5	Irwell	High
20. Rural Roch	6	Irwell	Low

Table 5-7: Generic CFMP Policy

Policy 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)

5.2.4. Current and Future Flood Risk in Rochdale MBC

Identification of Flood sources

Flooding from Rivers

The historic flood event search, the EA, the City Council, and the CFMP all suggest that one of the main flood risks within the District is flooding from rivers. Upper reaches of rivers in the catchment are susceptible to short-term intense rainfall events such as thunderstorm activity where large volumes of water are confined to relatively narrow river valleys. Areas surrounding confluences of tributaries and main channels such as the confluence of the Spodden and Roch in Mitchell Hey, and Wince Brook and the Irk to the south of Middleton, and where the Tong End Brook joins the Spodden in Whitworth, have an increased flood risk, particularly if flood peaks on both watercourses coincide or flow exceeds culvert capacity. As Rochdale is heavily urbanised area in places, many watercourses are culverted in sections and so flooding due to flow restrictions, which can be attributed to sedimentation and blockage of structures and weirs, is a risk and a known problem in Middleton. This type of flooding is primarily found upstream of structures when water backs up behind the blockage and ultimately overtops the channel.

Whilst fluvial flooding poses a significant to the District, 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.

Flooding from the Land

During periods of prolonged rainfall events and sudden intense downpours, overland flow from adjacent 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. Surface water flooding is a known issue in Littledistrict, Middleton and Rochdale.

Flooding from Sewers

Sewer flooding is another serious flood risk throughout the District, particularly during severe rainfall events, where the design capacity of the sewer network is insufficient to cope with the high volumes of water. Sewer flooding is a known issue in Rochdale, Heywood and Littleborough. During periods of high river flow, there is the potential for such drainage systems to become ‘tide locked’ and unable to discharge to the watercourse. The water then backs up and will again start to discharge. Sewer flooding was identified using historical records from United Utilities DG5 database (June 2007) detailing the total number of flood events that affected both internal and external property.

It should be noted that much of the sewer network is thought to date 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 the WRC “Sewers for Adoption”[27] 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 this design standard is not achieved. It is therefore likely that much 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.

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) (Figure 5-2) 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 that is also covered by the Data Protection Act (1998). As reflected in the historical records, Rochdale MBC had 50 recorded incidents of internal flooding on the DG5 register most of which occurred around Heywood, Rochdale and Wardle. As a result, a detailed analysis of the scale and consequences of sewer flooding has not been possible at this stage of the SFRA.

[27] Sewers for Adoption, Wrc Publications 2006

However, during the course of this study, 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 and AGMA have agreed to share data on drainage and development areas initially for Bury and Salford. This will allow both UU and AGMA to determine the usefulness of the data and to agree how it can be spatially represented on a sub-regional and strategic basis for the whole of the AGMA area. It is anticipated that both UU and AGMA will have agreed the scale and format of the data in time for more detailed Level 2 assessments.

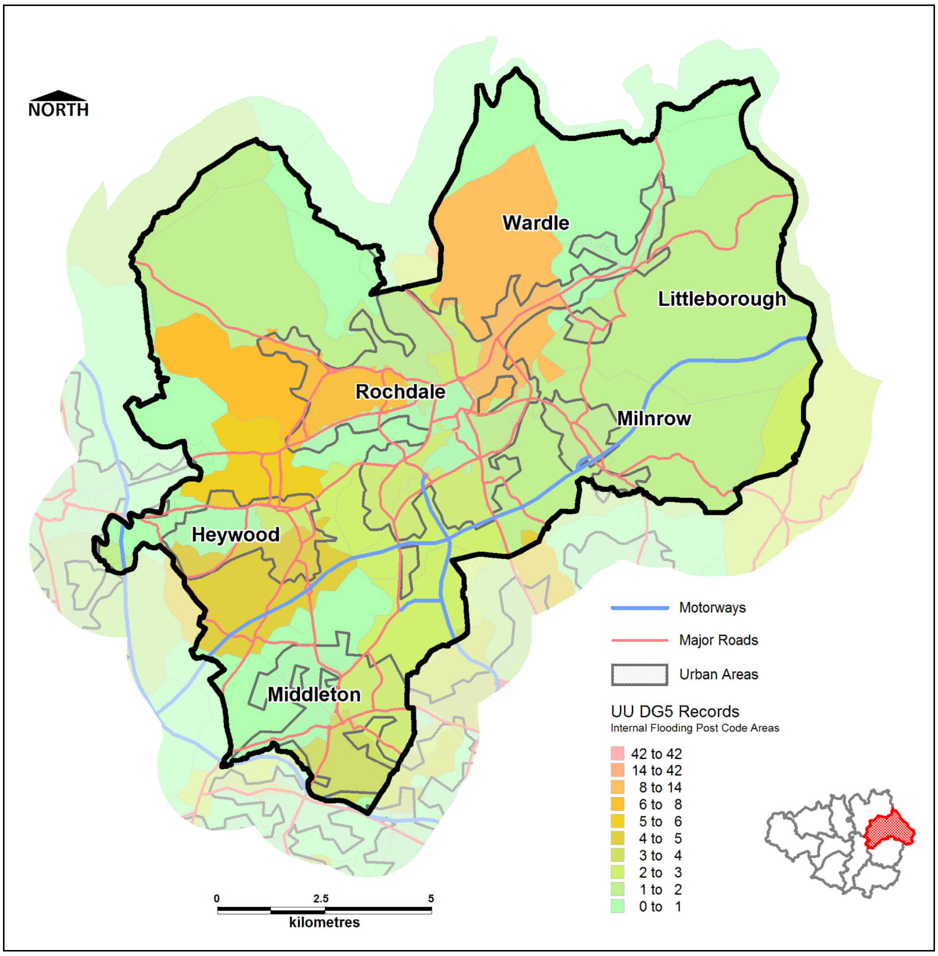


Figure 5-2: Rochdale UU DG5 data (June 2007) showing instances of Internal Flooding by five-digit postcode area.

Flooding from Reservoirs, Canals and Other Artificial Sources

There are a number of reservoirs in and upstream of the District such as the Naden and Greenbooth Reservoirs. Reservoirs have an attenuating effect on flood flows and can be used to control flows though it should be noted that none of them have been designed or operated for FRM purposes. Reservoirs do however have a flood risk associated with them in terms of dam/reservoir wall failure and emergency releases into the catchment. The likelihood of this occurring is minimal but impacts are potentially extremely high due to the limited warning time available and the potential high velocity and high volume flows. With so many reservoirs affecting the council, it may be necessary to consider the residual risks of breaching in terms of flood risk emergency planning and warning.

The Rochdale Canal runs through the District. 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 remains where water levels could overtop or breach embanked sections and there is a report of overtopping from the canal in July 1927.

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 have revealed no reported incidents of groundwater flooding in the District.

British Geological Survey (BGS) Maps show the area to be underlain primarily by mudstone, siltstone and sandstone. As a result, the EAs groundwater vulnerability maps show that much of the District is classified as minor aquifer with approximately half being of lower permeability and half being of higher permeability. Superficial deposits in Rochdale consist primarily of peat, glacial till with some glacio-fluvial deposits consisting of sand and gravel deposits.

The impacts of increased development in these areas must therefore be carefully assessed especially as surface water flooding has been recorded in the District. For example, larger infiltration based SuDS methods may less suitable in the glacial tills (with a high, less permeable clay content) and may actually increase groundwater levels locally. As a result, small scale soakaways or attenuation schemes may be a more suitable SuDS method through much of Rochdale MBC. In addition, deep excavations for new development (for example, underground car parks and basements, or new infrastructure tunnels) should be carefully assessed to determine what risk is posed.

Fluvial Flood Zones

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 and each outline used to create the SFRA flood zones assumes that no defences exist. There are no areas of tidal flood risk within the AGMA sub-region.

However, there are areas where little or no accurate flood outlines exist, and therefore, to ensure a continuous coverage across a flood zone, less accurate, broad-scale modelled (the EA J-FLOW Flood Zones) outlines were used instead. This hybrid approach provides a conservative flood zone and highlights potential uncertainties that can either be resolved in more detail at Level 2, or by developers as part of site-specific FRAs. The SFRA has identified the following flood zones in accordance with PPS 25

Flood Zone 1: Low Probability of Flooding
Land having a less than 1 in 1000 annual probability of river 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%) in any year. However, for the rest of Rochdale MBC, no detailed modelled outlines exist for Flood Zone 2 and therefore, the EA broad-scale Flood Zone 2 maps were used.

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

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. Where possible, 1:20 or 1:25 year detailed modelled outlines were used to define the functional floodplain. Some defended areas may include flood storage basins which are by their very nature functional floodplain. 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 in the data and potential tasks for the more detailed Level 2 assessments. 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.

Using the Flood Zone maps, the total area of Rochdale at risk of fluvial flooding can be determined. Table 5-8 and Figure A-5 (Appendix A) show that significant areas of the district are at risk of fluvial flooding, with approximately 4% of the district area affected by Flood Zones 2 and 3.

Table 5-8: Area of Fluvial Flood Risk to Rochdale MBC

District Area (ha)	Urban Area (ha)	Fluvial Flood Zone	Area (ha)	% (of District or Urban Area)
15,757.00	3,998.57	FZ3b	299.76	1.90
		FZ3a	193.14	1.23
		FZ3 in Urban	138.58	3.47
		FZ3 + CC	53.90	0.34
		FZ2	171.55	1.09
		FZ2 in Urban	105.91	2.65

Note: Figures for FZ3a refer to the area outside of FZ3b, figures for FZ3+CC and FZ2 refer to the area outside of FZ3a.

Flood Zone Confidence

Flood Zone Confidence Maps are intended to be used by planners as a tool for identifying areas of high, medium or low confidence in the data that has been used to derive fluvial Flood Zones across the sub-region. The confidence assigned to a Flood Zone demonstrates the level of detail and the number of assumptions made when deriving the Flood Zones.

Table 5-9 illustrates the confidence assigned to the Flood Zones present within the Rochdale MBC district. A map showing confidence in the each of the Flood Zones is presented at the end of this section (Figure Rochdale Overview/03).

Table 5-9: Fluvial Flood Risk Confidence for Rochdale MBC

<table>
<tr><th>District</th><th>Fluvial Flood Zone</th><th>Watercourse</th><th>Settlement</th><th>Source</th><th>Date of Modelling Study</th><th>Confidence</th></tr>
<tr><td rowspan="23">Rochdale</td><td rowspan="9">3b</td><td>All Other Watercourses</td><td>NA</td><td>EA Flood Zone Maps</td><td>NA (May 2008)</td><td>Low</td></tr>
<tr><td>River Irwell</td><td>Middleton</td><td>Irwell ABD (Draft)</td><td>2008 (May 2008)</td><td>Low</td></tr>
<tr><td>River Irk, Whit Brook</td><td>Middleton</td><td>Irk FRM Model</td><td>2003 (May 2008)</td><td>High</td></tr>
<tr><td>River Roch</td><td>Pimhole</td><td>Irwell Review Model</td><td>2007 (May 2008)</td><td>High</td></tr>
<tr><td rowspan="4">River Beal, River Roch</td><td>Milnrow</td><td rowspan="4">Roch Tributaries Model</td><td rowspan="4">2006 (May 2008)</td><td rowspan="4">High</td></tr>
<tr><td>Littleborough</td></tr>
<tr><td>Calderbrook</td></tr>
<tr><td>Rochdale</td></tr>
<tr><td>River Spodden</td><td>Rochdale</td><td>Spodden Model</td><td>2004 (May 2008)</td><td>High</td></tr>
<tr><td rowspan="10">3a</td><td rowspan="3">All Other Watercourses</td><td>Rochdale</td><td rowspan="3">EA Flood Zone Maps</td><td rowspan="3">NA</td><td rowspan="3">Medium</td></tr>
<tr><td>Littleborough</td></tr>
<tr><td>Middleton</td></tr>
<tr><td>River Spodden</td><td>Rochdale</td><td>Spodden</td><td>2004</td><td>High</td></tr>
<tr><td rowspan="4">River Beal, River Roch</td><td>Milnrow</td><td rowspan="4">Rochdale Tributaries (Draft)</td><td rowspan="4">2006</td><td rowspan="4">High</td></tr>
<tr><td>Littleborough</td></tr>
<tr><td>Calderbrook</td></tr>
<tr><td>Rochdale</td></tr>
<tr><td>River Roch</td><td>Pimhole</td><td>Irwell Review Model</td><td>2007</td><td>High</td></tr>
<tr><td>River Irwell</td><td>Middleton</td><td>Irwell ABD (Draft)</td><td>2008</td><td>High</td></tr>
<tr><td rowspan="4">3a + CC</td><td>River Roch</td><td>Pimhole</td><td>Irwell Review Model</td><td>2007</td><td>Low</td></tr>
<tr><td>River Irk, Whit Brook</td><td>Middleton</td><td>Irk FRM</td><td>2003</td><td>High</td></tr>
<tr><td rowspan="2">All Other Watercourses</td><td>Wardle</td><td rowspan="2">EA Flood Zone Maps - Flood Zone 2</td><td rowspan="2">NA</td><td rowspan="2">Low</td></tr>
<tr><td>Littleborough</td></tr>
<tr><td rowspan="4">2</td><td>River Irwell</td><td>Middleton</td><td>Irwell ABD (Draft)</td><td>2008</td><td>High</td></tr>
<tr><td rowspan="3">All Other Watercourses</td><td>Rochdale</td><td rowspan="3">EA Flood Zone Maps</td><td rowspan="3">NA</td><td rowspan="3">Medium</td></tr>
<tr><td>Littleborough</td></tr>
<tr><td>Middleton</td></tr>
</table>

Climate Change and Future Flood Risk

The CFMP's have 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 District. Defra/UKCIP (United Kingdom Climate Impacts Programme) 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. Water levels in the Rochdale to Littleborough area could increase by up to 0.5m (1 in 100 year event) and up to 25 more properties are at risk. In the rural Roch up to 10 more properties will be at risk.

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)[28] 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 runoff during storm events. The ASSCUE 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. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

The location of future urban developments and flood defences within a catchment can influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments. It may however be possible to mitigate against this 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.

To account for Climate Change at the sub-regional level, 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 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 Level 2 stage or during site specific FRAs (developer led).

Flood Risk Mitigation and Management

Flood Risk Management

Flood risk management assets may be hard formal structures designed for purpose such as flood walls, or they may be informal structures such as garden walls which were not designed specifically as defence structures, but are now performing that role. The National Flood and Coastal Defence Database (NFCDD) identifies any asset (including channels) that may have an impact on flood risk management and is constantly being updated and amended by the EA as a result of ongoing asset inspections. It should be noted that the database assigns a Standard of Protection (SoP) to flood defence assets and has a default value of 50 Years. Therefore the SoP values should be treated with caution and assessed (in conjunction with the EA) on a site-by-site

[28] 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

basis during the more detailed Level 2 SFRA. NFCDD data, along with CFMP's and council supplied information, have been used to identify the following major structures and flood defences assets in the District.

Reservoirs: Ashworth Moor
Naden reservoir
Greenbooth Reservoir
Watergrove

Bridges: Bridges at Littleborough, Smithy Bridge and Mitchell Hey could impede flow on River Roch

Defences: Defences at Rochdale, Littleborough, Middleton

By interrogating NFCDD outputs, a series of informative statistics about flood risk assets can be obtained. For Rochdale MBC, data from NFCDD shows that there are over 14km of culverted watercourses and 13km of man made raised flood defences, 4.17km of which have a SoP of between 21 and 50 years (Table 5-10).

Table 5-10: NFCDD data summarising lengths of flood defence asset in the Rochdale MBC Area (km) by Standard of Protection (return period in years).

Asset Type	Length of FRM Asset (km) by Standard of Protection in years					
	Unclassified	0-20	21-50	51-75	76-100	Total
Culverted Channel	0	0.00	14.12	0.00	0.36	14.48
Maintained Channel	0	0.00	1.48	0.00	0.08	1.55
Natural Channel	0	0.00	49.81	1.27	5.33	56.42
Flood Defence Structure	0	0.00	107.57	0.59	6.26	114.41
Non-Flood Defence Structure	0	0.00	0.81	0.02	0.07	0.91
Raised Defence (Man-Made)	0	0.00	8.90	0.00	4.09	12.99
Total	**0**	**0.00**	**182.7**	**1.88**	**16.18**	**200.75**

Mitigation

There are many different types of flood risk mitigation actions ranging from small, single dwelling flood proofing measures to flood warning services to large multi-million pound flood defence schemes.

There are flood warning areas in the Rochdale, Littleborough, Mitchell Hey, Mayfield, and Town Head areas which have been an effective mitigation measure for many years. However, flood warnings tend to work most effectively during large events with long lead times so that sufficient advance notice is given to residents and businesses and are usually only applicable to fluvial flooding. In the case of intense, flashy rainfall events, where pluvial and sewer flooding may pose the most risk, flood warnings schemes rarely exist.

The River Irwell CFMP identifies that the creation of flood storage areas upstream in the catchment in the headwaters of the Roch and Beal which could potentially reduce levels by 0.3-0.4m in Rochdale. It also identifies a potential washland area just west of Heywood at the confluence of the Roch and Irwell which could reduce levels downstream at Radcliffe by up to 0.4m and reduces peak flows by approximately 31 cumecs.

Risk of Failure of Defences and Impacts

Behind defended areas there is a residual risk of 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 tend to be low lying, and the water level will have often built up to a higher level than ground levels of the defended area. The same risks can be associated with reservoir/dam failure, though the risk of such failures is considered to be minimal.

People and Property at risk of flooding

The EA carried out a strategic review of flood risk for the whole of the North West Region[29.] This looked at the EA Flood Zones and the number of properties at risk of flooding within each District in the North West. Table 5-11 shows the number of properties at risk of flooding in each flood zone.

Table 5-11: Properties at risk of flooding (source: EA Flood Zone Ranking using EA Flood Zones)

FZ3	FZ2&3	FZ1	Total
2,093	3,523	90,966	94,489

Using census Output Area (OA) data (the smallest census geographical area), and updated mid-term 2005 population estimates for Rochdale, the potential populations affected by flooding in the different flood zones are presented in Table 5-12. 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 a district, 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 a CO by the type of accommodation they live in. Again, assuming an even distribution across a CO, an indication as to the predominant types of properties at risk can be shown

Table 5-12: Approximate number of people affected by fluvial flooding in Rochdale MBC

	Population at Risk (2005)	People living in House Bungalow	People living in Flat or Apartment	People living in Caravans or moveable Accommodation	People living in Shared Dwelling
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

[29] 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)

5.3. Strategic Overview of Flood Risk in Rochdale MBC

5.3.1. Consequences of Upstream and Downstream Development

Broad development upstream of Rochdale on the River Roch, Spodden, Beal and Irk catchments is defined within the RSS in terms of housing figures. The two districts upstream that are connected to Rochdale hydrologically therefore have the potential to adversely affect the current flood risk in Rochdale. As the district is located towards the upstream extent of the catchments there is potential for development both within and adjacent to, the AGMA sub-region to affect flood risk in Rochdale. 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.

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.

Should RSS housing targets be met, for example, a total of 9,200 new homes will be built in districts upstream of Rochdale (Oldham MBC and Rossendale DC). A further 118,040 homes are proposed in the 5 districts downstream of Rochdale Figure 5-3. These figures are for net new housing and so are additional to the current levels of development. Furthermore, all of the districts within the AGMA sub-region have a high target of for development on previously developed land (PDL). As a result, if no measures are taken to control runoff from new development, there is the potential for an increase in flood risk to Rochdale. In reality, however, it is likely that much of the new development will be constructed to modern and sustainable standards incorporating, where possible, SuDS to limit runoff.

Downstream and adjacent to Rochdale are Salford CC, Manchester CC, Trafford MBC, Bury MBC and Warrington MBC. Within the draft RSS, southeast Rochdale is highlighted as a Regional Investment Site and contains part of the Oldham-Rochdale HMR Pathfinder area. Development in Rochdale has the potential to impact on the flood risk of downstream and adjacent districts. As identified by the CFMPs, Rochdale contains areas to provide potential floodplain storage (for example in the headwaters of the Roch and Beal and a potential washland area just west of Heywood). However, to avoid reducing floodplain storage and potentially increasing flood risk downstream, development within and adjacent to these areas must be undertaken carefully so as not to adversely affect flood storage or flood flow routes. In addition, the incorporation of green open spaces and SuDS measures may help to reduce increased runoff.

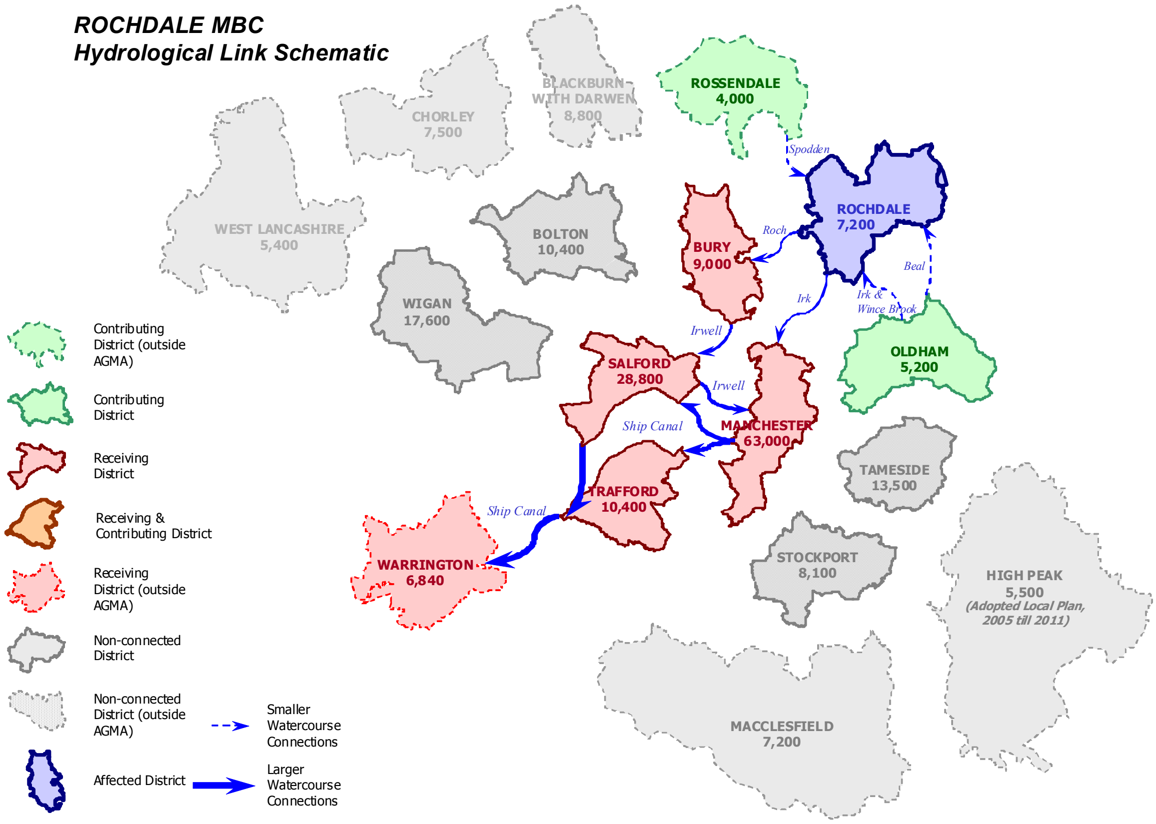


Figure 5-3: Hydrological Links for Rochdale MBC

5.3.2. Potential Conflicts between broad development aspirations in Rochdale and the PPS25 Sequential Test

As highlighted above, the current flood risk to the district is primarily from fluvial sources, in particular the River Roch and Irk. In addition, there is, at present, an unquantified risk of flooding from the Rochdale Canal. Most of the potential development locations are situated outside of the main flood zones, however, there are small areas of potential development, particularly in the south of Rochdale, Littleborough, Milnrow and Middleton that lie within flood zones 2 and 3.

Most of the proposed development areas are within populated areas in Rochdale. Therefore, there is potential for an increase in the amount of impermeable area and the subsequent increases in runoff and the impacts on surface water and sewer flooding. Using UU data and the Urban Morphology Types (UMT) boundaries from the ASSCUE project the percentage of impermeable areas within the district can be identified and it is recommended that the risks associated with potential surface water (pluvial) and sewer flooding in these areas is examined in more detail at the Level 2 assessment stage.

As a result, potential conflicts exist between development and the PPS25 Sequential Test in these areas. In order to examine these in more detail, it will be necessary to create maps showing more detailed flood outlines taking into account functional floodplain and climate change (as per PPS25 requirements) and displaying the risk associated with the Rochdale Canal during Level 2 assessments.

5.3.3. Impacts on and from other strategic spatial considerations

Other spatial considerations that Rochdale MBC should take account of with regards to flood risk include the Greater Manchester Green Infrastructure Scoping Study 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 areas on the Irwell upstream of Bury that have a building density of less than 1.25%. This correlates with the Irwell CFMP findings on potential for storage in the catchment. It is important that such 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.

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.

Waste and hazardous substances can also be affected by flooding and potentially introduce harmful and polluting substances into flood waters for transport and distribution elsewhere. The Greater Manchester Waste DPD is currently being undertaken and identifies current and future areas for waste management, storage and transfer. Using this in conjunction with the SFRA may help to reduce the risk of flooding to waste sites.

5.3.4. Strategic Effects of Defence failure

Impacts of defence failure include fast flowing, deep water which has the potential to cause major damage and loss of life within the District. At this time, it is not thought that the impacts of defence failure in Rochdale will adversely impact on districts downstream.

5.3.5. Identifiable Strategic Mitigation Options

Strategic options for mitigation include the upstream flood storage schemes. The River Irwell CFMP identifies that the creation of flood storage areas upstream in the catchment in the headwaters of the Roch and Beal which could potentially reduce levels by 0.3-0.4m in Rochdale. It also identifies a potential washland area just west of Heywood at the confluence of the Roch and Irwell which could reduce levels downstream at Radcliffe by up to 0.4m and reduces peak flows by approximately 31 cumecs.

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 catchment is reduced. Furthermore, and working closely with the outputs from the current sub-regional Green Infrastructure study, careful land use planning and the gradual reinstatement of green open spaces together with wetlands and woodlands throughout the catchment may help to further reduce runoff.

Rochdale_Overview/01

Rochdale_Overview/02

Rochdale_Overview/03

6. Salford City Council

6.1. Salford Development and Planning Context

The city of Salford is home to some 216,000 people and covers a land area of approximately 9,700ha. Approximately two-thirds of the city's land area is urban and one-third is open space and land, mainly protected Green Belt.

Salford is located on the western side of the Greater Manchester conurbation. It is at the hub of the region's motorway (M60, M61, M62, M602) and rail network, with good links to Manchester International Airport. The city lies on the northern bank of the Manchester Ship Canal and is bisected by the Bridgewater Canal.

The inner city areas include Ordsall, Broughton, Kersal, Irwell Riverside, Langworthy, Claremont and Weaste & Seedley. These exhibit some of the worst characteristics of social deprivation and are subject to a wide range of national social and economic programmes and initiatives. Beyond the inner city are the suburbs of Worsley, on the Bridgewater Canal, Swinton and Walkden and the outer areas of Irlam, Cadishead and Little Hulton. In turn, these suburbs give way to large tracts of open countryside much of which is prime agricultural land.

The city is undergoing a wide-ranging process of regeneration centred on transforming the physical environment, improving housing and the local economy. In part, this is achieved by raising the skills and aspirations of local people whilst exploiting the opportunities which exist as a result of its connections to the Regional Centre. A map presenting planning information for Salford is included at the end of this section (Figure Salford Overview/02).

6.1.1. Strategic and Regional Position

The eastern fringe of the city adjoins Manchester with the River Irwell as a boundary. The City forms part of the Regional Centre as defined under the draft RSS (January 2007). Policy MCR2 in the Regional Spatial Strategy recognises the Regional Centre as being "the primary economic driver for the Region, providing the main focus for leisure, culture and tourism development. The area has seen rapid growth and expansion in recent times and regional policy will seek to ensure this continues. Within the "Arc of Opportunity" (policy MCR2, para 2), the RSS will support the major expansion of employment in knowledge-based industries and residential development will be encouraged provided it meets the following criteria:

- It is part of a mixed-use employment scheme comprising a good range of sizes, type and tenure.
- It contributes towards the vitality and viability of the regional centre.

- It will not be of a scale detrimental to other housing developments including HMR initiatives within the sub region.

Regional policy supports an increase in population within the area, major regeneration activity and the creation of sustainable communities. Plans and Strategies for the area should seek to encourage employment opportunities that accord with policy W3, which states, amongst other objectives, that full consideration is given to the scope for mixed-use development, particularly within main centres, and that *"Office development" should, as far as possible, be focused within the Regional Centre in accordance with … policy RDF1".*

6.1.2. Unitary Development Plan

Under the provisions of the Planning and Compulsory Purchase Act 2004 the current Unitary Development Plan for the city will be "saved" for 3 years, initially till 2009, where upon it will start to be replaced by the new Development Plan Documents. As it is unlikely that the full compliment of DPD's required to replace the UDP will be ready by 2009, the city council will seek approval to save a number of the polices for longer. The UDP policies identified within this document will be saved until or beyond 2009.

The UDP sets out a Spatial Framework for the city that sub-divides the city into five key areas. With the exception of Salford West and the Urban Fringe and Countryside areas, 3 of these sub-districts either border or form part of the Regional Centre. These provide the focus for significant levels of economic activity within the city, and are therefore likely to see the most development activity, in line with Policy MR2 of the RSS. These areas are:

Central Salford – is characterised by significant levels of deprivation and is likely to be a major focus for regeneration and considerable investment.

Regional Centre – Lying within parts of Central Salford, the Regional Centre includes Salford Quays, Media City, Chapel Street, the University and Ordsall Lane Riverside Corridor. The area is only separated from Manchester City Centre and Trafford by the River Irwell and Manchester Ship Canal. Its continued development and expansion is supported by the UDP and conforms to the objectives of the RSS.

Western Gateway – the Western Gateway stretches along the Manchester Ship Canal from the city's western boundary into the regional centre. It incorporates Salford Quays, Eccles, Northbank, Media City and the Barton Strategic Regional Site. These areas are functionally linked with key employment zones in the District of Trafford and only physically linked via the Centenary Bridge at Eccles. The area is a major economic driver for the region and further economic investment will be encouraged.

The UDP establishes the overarching policy framework within which the strategy to secure the implementation of the vision and objectives of the Spatial Framework, will take place. However, the UDP will eventually be replaced by the Local Development Framework, which comprises a suite of

Development Plan Documents and Supplementary Planning Documents, which will guide development in greater detail.

6.1.3. Local Development Framework

Timetable

The Local Development Scheme outlines the City Council's priority LDDs for production within the next three years and reflects the fact that regeneration within Salford is a priority for the City Council. Preparation of the Core Strategy is at its initial stages and the Council will be consulting on the Issues and Options during the period June to September 2008. Consultation on the Preferred Option is expected to take place in June/July 2009, culminating in an Independent Examination in February / March 2010 with anticipated adoption of the Core Strategy in November 2010. Preparation of the Allocations DPD will commence in June 2009. The ten Greater Manchester Authorities are preparing a Joint Waste DPD, which will be at the 2nd Stage Issues and Options Paper in June / July 2008. The preparation of the full compliment of DPDs in Salford is currently under review.

Regeneration

There are a number of major regeneration initiatives within Central Salford. These include:

- Housing Market Renewal (HMR) Pathfinder, one of only nine nationally,
- The New Deal for Communities programme centred on the Charlestown and Lower Kersal area,
- Media City and the BBC relocation,
- Ordsall, Greengate and Chapel Street and,
- Central Salford Urban Regeneration Company provides the overarching strategic context for the Central Salford area over the next 20 years. Central Salford underpins the Manchester Knowledge Capital initiative, helping to secure investment and developer interest internationally.

The regeneration of the city is a key driver to change and is stimulating growth and expansion of the Regional Centre as a whole.

Housing Land

The local authority is required to monitor housing policy and performance particularly in terms of net additional dwellings. The most recent details recorded are found within the council's Annual Monitoring Report (AMR), published for 2005-6.

In summary, continued regeneration of the city has seen both substantial clearance and reconstruction that has about a net increase in housing provision. Cumulative provision between 2002 and 2007 achieved 3,766 'net' new dwellings. Four out of five years of this monitoring period has seen gross completion rates exceed 1000 units per annum although this must be set against significant amounts of clearance, resulting in a varying net completions total. However, demolitions now appear to have reduced and future trajectories suggest that this trend is likely to continue over coming years. An assessment of the current re-development potential within the city together with the regeneration activity that is currently under way indicates that the level of new house building proposed in the Draft RSS should be exceeded.

Table 6-1 highlights the RSS Housing targets for Salford for the period 2003-2021 and Figure 6-1 highlights the current 2007 AMR housing trajectory.

Table 6-1: Regional Targets (2003-2021)

	Draft RSS
Overall Housing Increase 2003-21	28,800
Mean Annual Increase	1,600
Indicative Previously Developed Land	90%

The City Council has identified sites to come forward for housing, some of which are allocated for mixed–use development. Table 6-2 below represents the city council's assessment of residential development and quantifies the number of units that are likely to come forward over the RSS and Core Strategy periods. The figures for the RSS period show that the City Council expect the RSS target to be exceeded by 1,566 dwellings.

Table 6-2: Projected Housing Supply (2003-2026)

Period	**Projected Annual Completions**	**Net Number of Dwellings**	
2003-2007	Complete	3,766	Total over RSS period = 30,366
2007-2011	1,900	7,600	
2011-2016	2,000	10,000	
2016-2021	1,800	9,000	
2021-2026	1,500	7,500	Total over Core Strategy period = 37,866

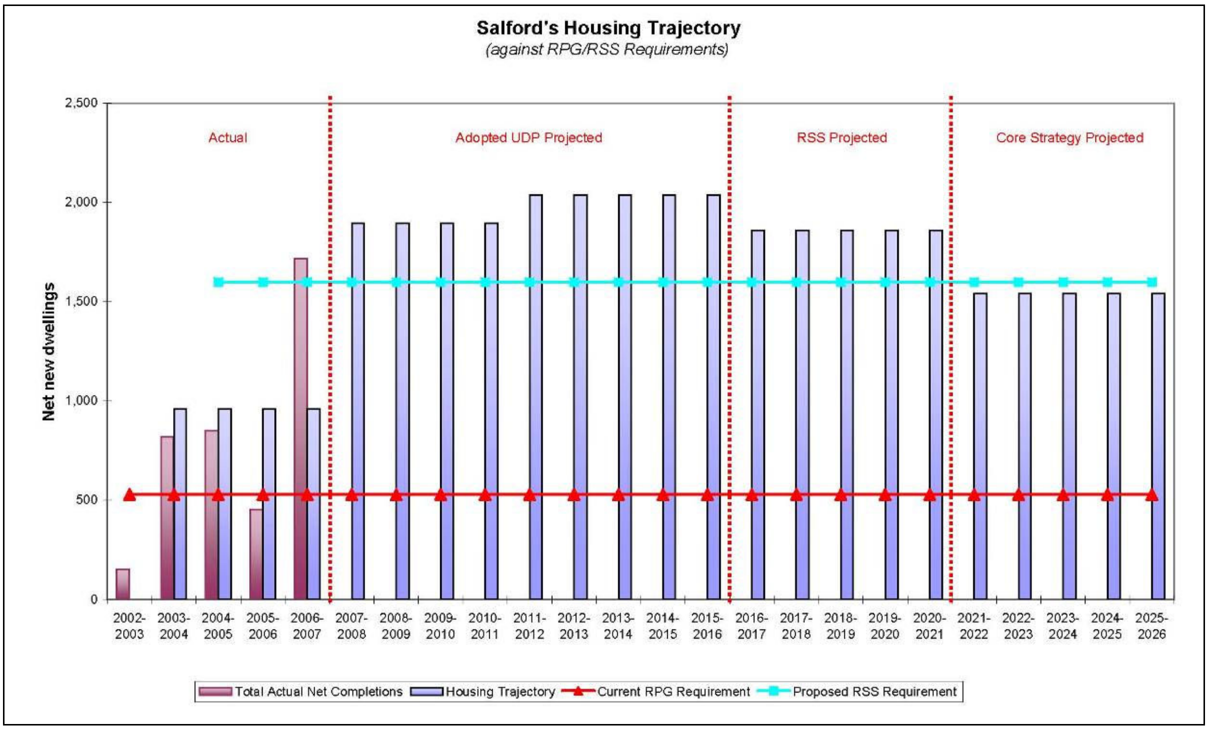


Figure 6-1: Salford CC Housing Trajectory

Employment Land

The UDP identifies a series of mixed-use areas within the Regional Centre, and major employment allocations at Barton and within the Western Gateway adjoining the Manchester Ship Canal. There is also a major site allocated for employment use within Little Hulton. The UDP outlines provision for 225.1 hectares of employment land for the period January 2004 - March 2016, though some of the allocated sites will not come forward in their entirety during the plan period. The allocations, together with sites within the mixed-use areas identified in Policy MX1 ‘Development in mixed-use areas’ of the Adopted UDP, will provide varied opportunities for economic development in many different sectors of the city’s economy. In addition to this, the UDP will enable the diversification of the local economy in a number of other ways, including supporting the:

- establishment of a Strategic Regional Site at Barton, including the potential to provide a Multi-Modal Freight Interchange;
- establishment of an Innovation Park;
- development, within the Chapel Street mixed-use areas, of a cultural and media hub as part of the Irwell Corridor Economic Development Zone, and a media link involving Greater Manchester’s four universities, focusing on Knowledge Capital; and

- continued development of Ordsall Riverside, Salford Quays and Media City as a major tourism destination, and appropriate tourism development elsewhere in the city.

6.2. Salford Flood Risk Summary

6.2.1. Hydrological background: catchment and watercourse network

The City of Salford lies within the Greater Manchester sub–region. Salford lies in the lower Irwell and Glaze Brook catchments and consequently is low lying and has relatively flat topography. The main watercourses in the District are the Manchester Ship Canal, the Bridgewater Canal, the River Irwell Worsley Brook and Glaze Brook, and smaller watercourses which include Folly Brook, Salteye Brook, Whitehead Brook, Singleton Brook and Platts Brook. All of these watercourses carry with them an inherent potential flood risk. The main urban areas at greatest risk from flooding in the District are Salford, Barton Upon-Irwell, Lower Kersal, Charlestown and Lower Broughton. A map presenting flood risk information for Salford is included at the end of this section (Figure Salford Overview/01). Table 6-3 shows the main watercourses and the urban areas at risk of flooding from each.

An SFRA was carried out for Salford City Council in 2005, however this covered the Lower Irwell Valley only with particular emphasis on providing planners with the tools to assess the flood risk implications of developing in the Lower Kersall, Lower Broughton and Charlestown areas. The River Irwell and Draft Mersey Estuary CFMPs provide catchment wide assessments of flood risk and are used by the EA to inform flood risk management strategy within a catchment. Both CFMPs also provide flood risk information of particular relevance to Salford that can be used to increase the quality and accuracy of flood risk information presented in the SFRA.

Table 6-3: Main Watercourses and Urban Areas at Risk

Main Watercourses	Urban area at risk
Irwell	Salford, Lower Broughton, Lower Kersal, Charlestown, Worsley and Walkden.
Manchester Ship Canal	Barton Upon Irwell
Worsley Brook	Swinton, Eccles
Shaw Brook	Glazebury, Worsley Moss

6.2.2. Historical Flooding

A review of the information supplied by the council, the EA, CFMP's, and through searching online historical records[30], has revealed that Salford has experienced a number of flood events throughout the last century. Searches have revealed that the area around Adelphi Weir, to the south west of Lower Broughton, has suffered prolific flooding however there is little indication as to extent or impact of flooding caused by these events. According to the EA HiFlows database, following repeated flooding at the Adelphi Weir site, flood defence works were carried out in the 1960's and the flooding problem decreased considerably. Historically the District has experienced flooding from the River Irwell, surface water and sewer flooding and flooding from the Manchester Ship Canal and Bridgewater Canal.

[30] British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe/

Lower Broughton Road has suffered particularly badly from Main River flooding and the Salford City Council SFRA identified this area as a historic flood path and low point within the floodplain and consequently a natural preferred flood route. The same SFRA identified sewer and drainage flooding hotspots in Higher Broughton, Swinton, Ellesmere Park, Boothstown, Walkden and Little Hulton from records held by the Council, in particular, Salford City Highways.

Table 6-4 summarises a number of significant fluvial historical flood events, whilst Table 6-5 highlights the sewer and drainage flooding hotspots. The information has been gathered from various sources, including the City Council, the EA, CFMPs, the original Salford SFRA, and the British Hydrological Society (BHS) Chronology of British Hydrological Events online database hosted at the University of Dundee. Where information permitted, the month of the flood was included (though this data was not always available), which shows that most recorded instances of flooding occurred in late summer and autumn (August to November) or early winter (December to February). It should also be noted that historical records do not always include details of what the flooding mechanisms and causes were for a particular event.

Table 6-4: Significant historic flood events in Salford CC

Date	Location	Source of flooding	Impact	Source of data
1886	Irwell, Salford	Fluvial	800 ha land flooded	BHS Database
Aug-1909	Irwell at Adelphi Weir, Salford.	Fluvial		BHS Database
Aug-1912	Irwell at Adelphi Weir, Salford.	Fluvial		BHS Database
Feb-1920	Irwell at Adelphi Weir, Salford.	Fluvial		BHS Database
Dec-1921	Irwell at Adelphi Weir, Salford.	Fluvial		BHS Database
Nov-1923	Irwell at Adelphi Weir, Salford.	Fluvial		BHS Database
Feb-1925	Irwell at Adelphi Weir, Salford.	Fluvial		BHS Database
1946	Irwell, Salford	Fluvial	5,300 properties flooded	Irwell CFMP
Sep-1946	Flood on Irwell at Adelphi Weir, Salford.	Fluvial	234 ha flooded, 5,000 residential and 300 industrial	Irwell CFMP
1954	Irwell, Salford	Fluvial	600 properties flooded	Irwell CFMP
1980	Irwell, Salford	Fluvial	Flooded flats in Lower Kearsley	Irwell CFMP
1983	Irwell, Salford	Fluvial	Minor flooding	Irwell CFMP
Aug-2004	Barton upon Irwell	Overtopping of MSC, Fluvial	Localised Flooding of 16 houses	Salford City Council SFRA

Table 6-5: Sewer and Drainage Flooding Hotspots from the Salford City Council SFRA and Council Records

Date	Location	Impact	Source of Information
Repeated instances. Notable events include: JULY 1995, MAY 1997, MAY 1999, JULY 1999, AUG 1999, JULY 2001, JUNE 2002, AUG 2004	Barton		Salford City Council SFRA
	Boothstown, Walkden North & South & Ellenbrook	Sewers surcharged due intense rainfall. Properties affected by cellar flooding and also some roads and gardens.	Salford City Council SFRA
	Broughton	Cellars flooded to a depth of about 0.5m with sewerage.	Salford City Council SFRA
	Claremont		Salford City Council SFRA
	Eccles		Salford City Council SFRA
	Ellesmere Park	Cellars flood with foul water due to blockages and tree roots in sewers, and close proximity of sewers to the level of the cellars.	Salford City Council SFRA
	Kersal		Salford City Council SFRA
	Little Hulton	Flooding of roads and gardens.	Salford City Council SFRA
	Swinton North & South	Foul flooding of gardens.	Salford City Council SFRA
	Weaste & Seedley		Salford City Council SFRA
	Winton		Salford City Council SFRA

6.2.3. 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 would be required at Level 2.

Overall the SFRA represents a comprehensive overview of flood risk across the district. Detailed 2-Dimensional Modelling was undertaken for some of the principal floodplains of the River Irwell, most notably, Lower Kersal Charlestown and Lower Broughton to determine risk, parameters relating to direction of flow and potential depth of flooding.

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 detailed further downstream. Should more detailed information be forthcoming on the Ship Canal, then this data must be incorporated into the updated SFRA.

6.2.4. CFMP Assessment of Flood Risk

The District is covered by the draft Mersey Estuary CFMP and the River Irwell Pilot CFMP. Draft policies are subject to change and the SFRA must be adapted accordingly. The CFMPs have split the City into five spatial areas, each assigned with a degree of risk (high, medium and low) as displayed in Table 6-6. The CFMP also recommends a preferred policy option for each unit. The generic policy options are shown in Table 6-7.

Table 6-6: Flood Risk by Area as indicated in CFMP for Salford CC

Policy Unit	Policy Option	CFMP	Risk
1: Manchester to Irlam (MSC)	4	River Irwell	Low
3. Salford flood risk area (Irwell)	5	River Irwell	High
4. Kearsley to Kersal (Irwell)	6	River Irwell	Low
10: Swinton and Eccles	5	River Irwell	Medium/High
1: Glaze	2	Mersey Estuary	Low

Table 6-7: Generic CFMP Policies

Policy 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)

6.2.5. Current and Future Flood Risk in Salford City Council

Identification of Flood sources

Flooding from Rivers

The historic flood event search, the EA, the City Council, CFMP and the previous SFRA all suggest that the main flood risk (in terms of magnitude and impacts) within the District is flooding from rivers. Settlements adjacent to lower reaches of rivers, such as Lower Broughton and Lower Kersal, tend to be more at risk from fluvial flooding attributed to prolonged rainfall activity as the naturally flatter topography drains a larger catchment area. Areas surrounding confluences of tributaries and main channels have an increased flood risk, particularly if flood peaks on both watercourses coincide or flow exceeds culvert capacity.

Salford City Council calculates that 10,226 existing properties are in flood zone 3 'high risk', of flooding, of which 9,836 are residential properties. A further 2,233 properties are in flood zone 2 'medium' risk of flooding[31]. Areas at particular risk of flooding in the District are Lower Kersal, Lower Broughton and Charlestown.

Flooding due to flow restrictions such as sedimentation, blockage or collapse of channels and structures such as culverts and weirs is a potential risk. This type of flooding is primarily found upstream of structures when water backs up behind the blockage and ultimately overtops the channel. With areas of Salford being heavily urbanised, there are numerous such structures and are therefore potentially at risk from such flooding.

Whilst fluvial flooding poses a significant risk to the City, 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.

Flooding from the Land

During periods of prolonged rainfall events and sudden intense downpours, overland flow from adjacent higher ground may 'pond' in low-lying areas of land without draining into watercourses, surface water drainage systems or the ground. Anecdotal evidence from Salford City Council and the SFRA suggests that pluvial and surface water flooding could have occurred in the past though no specific incidents have been recorded. Pluvial and surface water flooding is most likely to occur in areas of poor permeability and limited drainage and on steeper slopes. 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

[31] Salford City Council SFRA, 2005

more frequent and, although not on the same scale as fluvial flooding, it can still cause significant disruption.

Flooding from Sewers

Sewer and drainage flooding are another flood risk throughout the District, 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 resulting in the system backing up, surcharging and flooding roads and properties. Alternatively, blockages to sewers and limited capacity can also cause water to back up and surcharge. Sewer flooding was identified using historical records from United Utilities DG5 database (June 2007) detailing the total number of flood events that affected both internal and external property. Sewer flooding is known to have occurred in Salford where up to 1,000 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.

It should be noted that much of the sewer network is 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.

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) (Figure 6-2) 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 that is also covered by the Data Protection Act (1998). As a result, a detailed analysis of the scale and consequences of sewer flooding has not been possible at this stage of the SFRA.

However, 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 and AGMA have agreed to share data on drainage and development areas initially for Bury and Salford. This will allow both UU and AGMA to determine the usefulness of the data and to agree how it can be spatially represented on a sub-regional and strategic basis for the whole of the AGMA area. It is anticipated that both UU and AGMA will have agreed the scale and format of the data in time for more detailed Level 2 assessments.

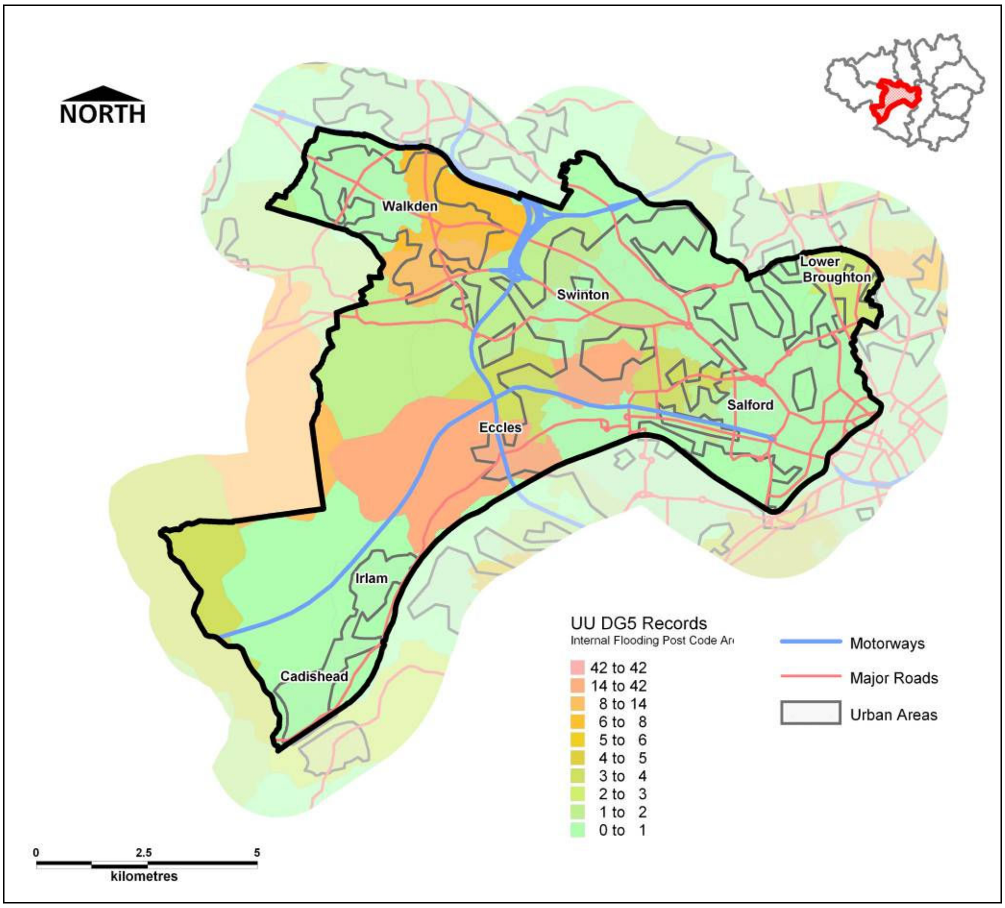


Figure 6-2: UU DG5 data (June 2007) showing instances of Internal Flooding by five-digit postcode area for Salford CC.

Flooding from Reservoirs, Canals and Other Artificial Sources

The Manchester Ship Canal and Bridgewater Canal run through the District. There are few recorded instances of flooding from the canal networks as they tend to be heavily regulated and controlled. One such instance occurred in August 2004, where 16 properties in Barton-Upon-Irwell were flooded by the Manchester Ship Canal overtopping. Nonetheless, flood risk from canals and navigable waterways still remains where water levels could overtop or breach embanked sections. 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.

In depth discussions have been held with MSCC to determine what, if any, flood risk information and knowledge is available for strategic planning purposes in the SFRA. MSCC commissioned a detailed modelling exercise of the canal[32] to determine how the canal will react during a flood event and to enable the most efficient operational response. This exercise is nearing completion

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

though the full results are not expected until the end of the autumn of 2007. Once the study is complete, MSCC intend to provide the information to the EA to review and determine the flood risk issues. 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. This is expected to happen during more detailed Level 2 assessments.

Flooding from Groundwater

British Geological Survey (BGS) Maps show the area to be underlain by more permeable rocks consisting primarily of coal measures, interspersed with mudstones, siltstones and sandstones (cyclothem). As a result, the EAs groundwater vulnerability maps show that much of the southern and eastern areas (following the Irwell and MSC corridor) of the City Council is classed as a Major Aquifer (consisting primarily of the Sherwood Sandstone Aquifer).

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 have revealed no reported incidents of groundwater flooding in SCC. However, work undertaken by the EA recently[33] has suggested that the cessation of mine dewatering and the slowing of abstraction from the aquifers, has led to an increase in groundwater levels, or groundwater rebound.

Searches revealed relatively few reported incidents of groundwater flooding in the District. However, work undertaken by DEFRA and the EA has shown that flooding from groundwater is shown to become a potential issue in Salford City Council 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 EAs water resources team and groundwater assessments undertaken in the Lower Broughton Area[34], the risk posed by localised groundwater flooding is likely to remain remote. However, this could become more of an issue in certain areas of the district due to the rising groundwater levels and the major aquifer –

[33] Groundwater Flood Risk and Management in the North West Region, Environment Agency, 2007.
[34] Lower Broughton Groundwater Flood Risk Assessment, Scott Wilson, September 2007.

especially those abutting the MSC and River Irwell., where local groundwater levels may be influenced by the river and canal.

The impacts of increased development in these areas must therefore 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.

Fluvial Flood Zones

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 and each outline used to create the SFRA flood zones assumes that no defences exist. There are no areas of tidal flood risk within the AGMA sub-region.

However, there are areas where little or no accurate flood outlines exist, and therefore, to ensure a continuous coverage across a flood zone, less accurate, broad-scale modelled (the EA J-FLOW Flood Zones) outlines were used instead. This hybrid approach provides a conservative flood zone and highlights potential uncertainties that can either be resolved in more detail at Level 2, or by developers as part of site-specific FRAs. The SFRA has identified the following flood zones in accordance with PPS 25

Flood Zone 1: Low Probability of Flooding
Land having a less than 1 in 1000 annual probability of river 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%) in any year. Detailed modelling to determine the 1000yr flood outline has recently been completed by the EA on the River Irwell[35]. Similar modelling was carried out during the original Salford SFRA on sites in the River Irwell Floodplain.

Flood Zone 3a: High Probability of Flooding
Land having a 1 in 100 annual probability of river flooding (>1%) in any year. A hybrid FZ3a map was produced using a variety of different modelled outlines, including those from the detailed 2D modelling carried out in the original Salford SFRA. Where modelled outlines did not exist, the EA broad-scale Flood Zone 3 maps were used instead.

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

[35] River Irwell Model Review and Update, Environment Agency, October 2007.

between the LPA and the Environment Agency. Where possible, 1:20 or 1:25 year detailed modelled outlines were used to define the functional floodplain. Some defended areas may include flood storage basins which are by their very nature functional floodplain. 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 in the data and potential tasks for the more detailed Level 2 assessments. 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.

Using the Flood Zone maps, the total area of Salford at risk of fluvial flooding can be determined. Table 6-8 and Figure A-5 (Appendix A) show that significant areas of the district are at risk of fluvial flooding, with approximately 8% of the district area affected by Flood Zones 2 and 3.

Table 6-8: Area of Fluvial Flood Risk to Salford City Council

District Area (ha)	Urban Area (ha)	Fluvial Flood Zone	Area (ha)	% (of District or Urban Area)
9687.81	4,046.73	FZ3b	290.00	2.99
		FZ3a	114.53	1.18
		FZ3 in Urban	141.75	3.50
		FZ3 + CC	334.39	3.45
		FZ2	355.16	3.67
		FZ2 in Urban	167.47	4.14

Note: Figures for FZ3a refer to the area outside of FZ3b, figures for FZ3+CC and FZ2 refer to the area outside of FZ3a.

Flood Zone Confidence

Flood Zone Confidence Maps are intended to be used by planners as a tool for identifying areas of high, medium or low confidence in the data that has been used to derive fluvial Flood Zones across the sub-region and also to determine where further work is required. The confidence assigned to a Flood Zone demonstrates the level of detail and the number of assumptions made when deriving the Flood Zones. The maps can be used to determine reaches of river where further, more detailed work is required to refine Flood Zones and therefore where resources should be directed.

Table 6-9 illustrates the confidence assigned to the Flood Zones present within the Salford MBC district. A map showing confidence in the each of the Flood Zones is presented at the end of this section (Figure Salford Overview/03).

Table 6-9: Fluvial Flood Risk Confidence for Salford MBC

District	Fluvial Flood Zone	Watercourse	Settlement	Source	Date of Modelling Study	Confidence
Salford	3b	All Other Watercourses	Cadishead	EA Flood Zone Maps	NA (May 2008)	Low
			Irlam			
		River Irwell	Salford	Irwell ABD (Draft)	2008 (May 2008)	Low
		Glaze Brook	Cadishead	Middle Lower Mersey Model	2001 (May 2008)	High
		Worsley Brook	Walkden	Worsley SFRM	2008 (May 2008)	High
			Eccles			
	3a	Glaze Brook	Cadishead	Middle Lower Mersey Model	2001	High
		All Other Watercourses	Irlam	EA Flood Zone Maps	NA	Medium
		Worsley Brook	Walkden	Worsely SFRM	2008	High
			Eccles			
		River Irwell	Salford	Irwell ABD (Draft)	2008	High
	3a + CC	Worsley Brook	Walkden	Worsely Brook SFRM	2008	High
			Eccles			
		River Irwell	Salford	Irwell ABD (Draft) - Flood Zone 2	2008	Low
		All Other Watercourses	Cadishead	EA Flood Zone Maps - Flood Zone 2	NA	Low
			Irlam			
	2	Worsley Brook	Walkden	Worsely SFRM	2008	High
			Eccles			
		All Other Watercourses	Irlam	EA Flood Zone Maps	NA	Medium
		River Irwell	Salford	Irwell ABD (Draft)	2008	High

Climate Change and Future Flood Risk

The CFMP's have 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 District. Defra/UKCIP (United Kingdom Climate Impacts Programme) 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. Results showed an average increase in flows of 25% across the Glaze Brook catchment. Water levels in Salford could increase by up to 1.1m, putting 1,000 more properties at risk from flooding.

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)[36] 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 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. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

The location of future urban developments and flood defences within a catchment can influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments. The City of Salford SFRA found that the floodplains of Lower Kersal, Charlestown and Lower Broughton are hydraulically linked and therefore any alteration to the hydrological regime in one floodplain is likely to impact on the others. This must be borne in mind when planning future development. It may however be possible to mitigate against this 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.

To account for Climate Change at the sub-regional level, 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 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 Level 2 assessment or Site Specific FRAs (developer led).

Flood Risk Management and Mitigation

Flood Risk Management

Flood risk management assets may be hard formal structures designed for purpose such as flood walls, or they may be informal structures such as garden walls which were not designed specifically as defence structures, but are now performing that role. The National Flood and Coastal Defence Database (NFCDD) identifies any asset (including channels) that may have an impact on flood risk management and is constantly being updated and amended by the EA as a result of ongoing asset inspections. It should be noted that the database assigns a Standard of Protection (SoP) to flood defence assets and has a default value of 50 Years. Therefore the SoP values should be treated with caution and assessed (in conjunction with the EA) on a site-by-site

[36] 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

basis during the more detailed Level 2 stage. NFCDD data, along with CFMP's and council supplied information, have been used to identify the following major structures and flood defences assets in the District.

Bridges: Bridges at Lower Kersal and Charlestown can impede flow at Salford on the Irwell

Culverts and weirs: Numerous culverts and weirs on all watercourses- risk of collapse

Flood Control: Lower Irwell Flood Risk Management Strategy flood control scheme protects Lower Kersal, Lower Broughton and Charlestown with a combination of raised defences consisting of earthen and hard structural embankments, and flood walls

Storage Basin: Littleton Road storage basin, capacity 650,000m^3

By interrogating NFCDD outputs, a series of informative statistics about flood risk assets can be obtained. For Salford City Council, data from NFCDD shows that there are over 10km of culverted watercourses and 9.5km of man made raised flood defences, 9.25km of which have a SoP of between 21 and 50 years (Table 6-10). This is significant as much of Salford lies within the FZ3 and FZ2 (Figure A-5) and large areas of Salford (in particular) Lower Broughton, Lower Kersal and Charlestown) are at risk of flooding and rely on flood defences to reduce flood risk.

Table 6-10: NFCDD data summarising lengths of flood defence asset in the Salford CC Area (km) by Standard of Protection (return period in years).

Asset Type	Length of FRM Asset (km) by Standard of Protection in years					
	Unclassified	0-20	21-50	51-75	76-100	Total
Culverted Channel	0.00	0.04	10.60	0.00	0.01	**10.65**
Maintained Channel	0.00	4.82	16.93	0.00	0.00	**21.75**
Natural Channel	0.00	0.00	41.72	0.00	0.58	**42.31**
Flood Defence Structure	0.00	0.00	1.43	0.00	0.00	**1.43**
Non-Flood Defence Structure	0.00	0.03	0.30	0.00	0.00	**0.34**
Raised Defence (Man-Made)	0.00	0.00	9.25	0.27	0.00	**9.53**
Total	**0.00**	**4.89**	**80.24**	**0.27**	**0.59**	**85.99**

Mitigation Measures

There are many different types of flood risk mitigation actions ranging from small, single dwelling flood proofing measures to flood warning services to large multi-million pound flood defence schemes.

There are flood warning areas in the lower reaches of the Irwell in the north east of the District which have been an effective mitigation measure for many years. However, flood warnings tend to work most effectively during large events with long lead times so that sufficient advance notice is given to residents and businesses and are usually only applicable to fluvial flooding. In the case of intense, flashy rainfall events, where pluvial and sewer flooding may pose the most risk, flood warnings schemes rarely exist.

The Salford City SFRA suggests that mitigation works that improve overland flood drainage in areas that are particularly susceptible to flooding, such as Charlestown and Lower Broughton, would aid sustainable development and flood risk in those areas. Providing for flood flows and storage during the planning and development layout design stage allows flood water to be stored and conveyed through a site without adversely impacting on properties or access and egress routes.

The Salford SFRA has also suggested that in the Lower Kersal area, mitigation against risk to life and property could be offered by constructing a low level bund to control the velocity of flood waters. Development here would also need to incorporate flood-proofing measures to individual properties and may include a range of devices designed to prevent individual properties from flooding.

Flood risk in Charlestown could be mitigated by improving overland flood flow routes. In Lower Broughton flood risk mitigation measures could include managing overland flood flow routes and improving flood plain storage, along with designing in flood proofing methods into developments. Scott Wilson are currently producing a Flood Risk Assessment for a residential development in Lower Broughton as part of a wider regeneration of the area, and are therefore taking into account mitigation measures required to minimise flood risk.

Salford City Council and the EA have recently, drafted a Planning Advice Note for Managing Flood Risk in Salford[37]. The note recommends that:

- Finished floor levels should be above the 100 year + 20% (included for climate change) event water level + an allowance for freeboard (to take account of uncertainties in the model prediction of flood levels.
- 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.
- Where the above standard cannot be achieved for reasons other than just cost, finished floor levels should be no more than 600mm below the 1:500 year event.
- Measures should be taken to prevent the conversion of ground floor non-habitable spaces into residential accommodation where this would result in habitable rooms being flooded to a depth greater than 600mm in the 1:1000 year event.
- All principal access and egress routes should be set to the 100 year plus 20% event water level plus a 600mm freeboard or other amount as agreed with the EA so that they remain dry during the 100 year plus 20% event.

The Salford SFRA and the Irwell CFMP identify that the creation of flood storage areas upstream in the catchment in Bury, Rochdale or Bolton would have limited benefits in Salford in terms of reducing flows and damages. Both the CFMP and City of Salford SFRA recognise that the provision of an additional storage basin just upstream of Salford, potentially in the Castle Irwell area.

Risk of Failure of Defences 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. The Salford City SFRA identifies the area of Lower Kersal which benefits from high elevation defences, to be at risk of high velocity flood water flow should defences breach. This is due to a powerful 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 causing extreme damage to property and putting 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. Figure 6-3 is an extract from the original Salford SFRA showing potential inundation depths under the 'possible' likelihood scenario.

[37] Planning Advice Note for Managing Flood Risk in Salford, Salford City Council, 2007.

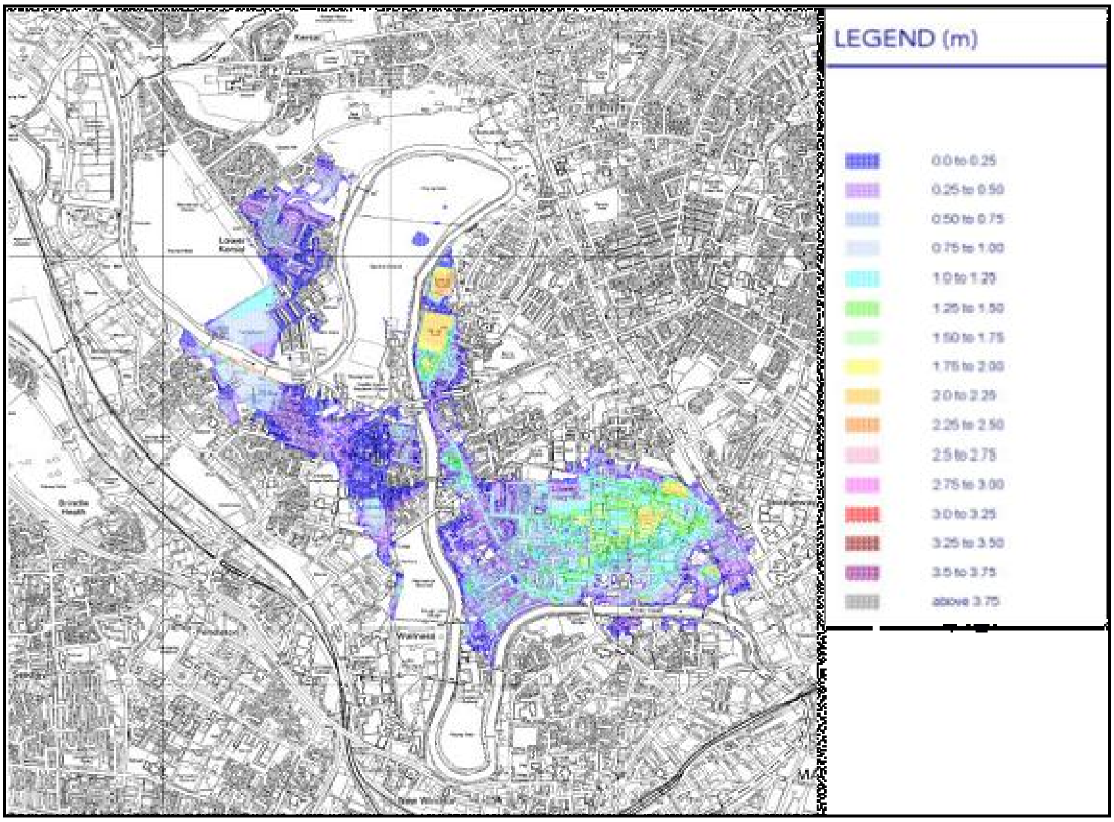


Figure 6-3: Map showing potential inundation depths extracted from City of Salford Strategic Flood Risk Assessment – November 2005

People and Property at risk of flooding

The EA carried out a strategic review of flood risk for the whole of the North West Region[38]. This looked at the EA Flood Zones and the number of properties at risk of flooding within each District in the North West. Table 6-11 shows the number of properties at risk of flooding in each flood zone calculated during the flood risk ranking study.

Table 6-11: Properties at risk of flooding (source: EA Flood Zone Ranking using EA Flood Zones)

FZ3	FZ2&3	FZ1	Total
10,233	12,477	96,055	108,532

[38] 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)

In addition to the work undertaken by the EA, Salford City Council calculates that 10,226 properties are at high risk of flooding, of which 9,836 are residential properties. A further 2,233 properties are at medium risk of flooding.

Using census Output Area (OA) data (the smallest census geographical area), and updated mid-term 2005 population estimates for Salford, the potential populations affected by flooding in the different flood zones are presented in Table 6-12. 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 a district, 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 a OA by the type of accommodation they live in. Again, assuming an even distribution across a OA, an indication as to the predominant types of properties at risk can be shown.

Table 6-12: Approximate number of people affected by fluvial flooding in Salford

	Population at Risk (2005)	People living in House Bungalow	People living in Flat or Apartment	People living in Caravans or moveable Accommodation	People living in Shared Dwelling
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

From these coarse statistics, it is can be seen that the majority of people potentially affected by fluvial flooding in Salford reside in detached houses or bungalows in flood zone 3a and Flood zone 2.

6.3. Strategic Overview of Flood Risk in Salford CC

6.3.1. Consequences of Upstream and Downstream Development

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 connected to Salford hydrologically 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 (Figure 6-4). 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.

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.

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. Furthermore, all of the districts have a high target for development on previously developed land (PDL). As a result, if no measures are taken to control runoff there is a potential for some of the new development to cause an increase in flood risk to Salford. Salford has the second highest housing target (28,800) under the RSS within the sub-region, with much of the proposed development areas either in the Western Gateway, Central Salford Inner Area or the Regional Centre. These areas are also those that follow the River Irwell and MSC corridors and therefore have a higher level of flood risk both currently and in the future. In reality, however, it is likely that new development will be constructed to modern and sustainable standards incorporating, where possible, SuDS to limit runoff.

Downstream and adjacent to Salford are Manchester CC, Trafford MBC, Wigan MBC and Warrington MBC. Development and expansion aspirations within Salford, as identified above in Section 3.1.2, are large and ambitious. Forming a key part of the Regional Centre and Inner Area (MCR2) in the RSS, development in Salford has the potential to impact on the flood risk of downstream and adjacent districts. As identified by the CFMPs and the original SFRA, key flood flow routes exist in areas of current and future development that provide floodplain storage (for example, Charlestown, Kersal and Lower Broughton). However, to avoid reducing floodplain storage and potentially increasing flood risk downstream, development within and adjacent to these areas must be undertaken carefully so as not to adversely affect flood storage or flood flow routes. In addition, the incorporation of green open spaces and SuDS measures may help to reduce increased runoff.

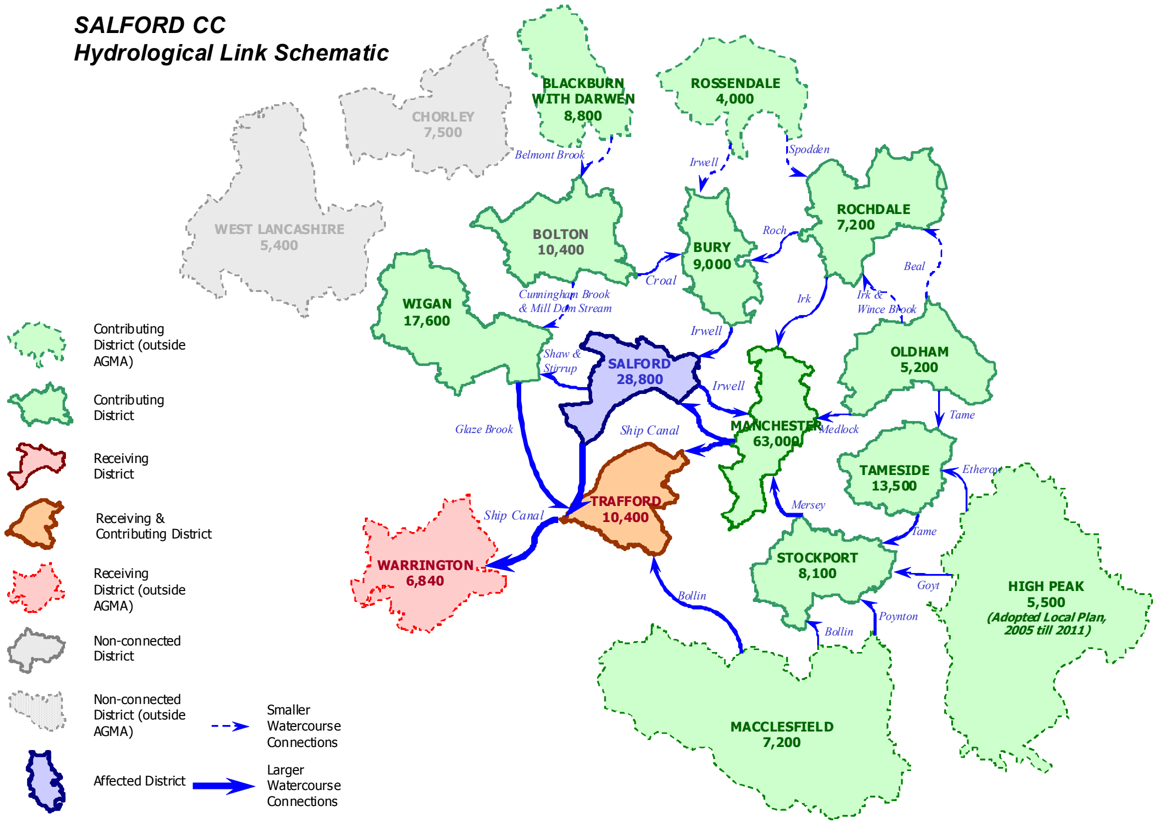


Figure 6-4: Hydrological links

6.3.2. Potential Conflicts between broad development aspirations and the PPS25 Sequential Test

As highlighted above, the main flood risk to the district is primarily from fluvial sources, in particular the River Irwell. Whilst on a smaller and more localised scale, significant and more frequent flooding problems have also been identified as a result of sewer and drainage issues. In addition, there is, at present, an unquantified risk of flooding from the Manchester Ship Canal. Both of the primary flood risk areas also coincide with Salford CC's aspirational broad development areas – The Regional Centre, The Central Salford Inner Area, through which the River Irwell flows, and the Western Gateway including the Strategic Regional Regeneration Area at Barton, Cadishead and the Salford Quays, which follows the northern bank of the MSC. In addition, there are parts of the Worsley Brook floodplain that may impact on the Barton Regeneration Area.

Most of the aspirational development areas, including the Regional Centre, Central Salford and the Western Gateway include some of the most densely populated areas in Salford. In addition, the RSS has identified a target of 90% of new development to occur on PDL and outside the large areas of greenbelt within the district. Therefore, there is potential for an increase in the amount of impermeable area and the subsequent increases in runoff and the impacts on surface water and sewer flooding. Using UU data and the Urban Morphology Types (UMT) boundaries from the ASSCUE project the percentage of impermeable areas within the district can be identified and it is recommended that the risks associated with potential surface water (pluvial) and sewer flooding in these areas is examined in more detail at the Level 2 stage.

As a result, potential conflicts exist between development and the PPS25 Sequential Test in these areas. In order to examine these in more detail, it will be necessary to create maps showing more detailed flood outlines taking into account functional floodplain and climate change (as per PPS25 requirements) and displaying the risk associated with the MSC during a more detailed Level 2 assessment.

6.3.3. Impacts on and from other strategic spatial considerations

Other spatial considerations that Salford CC should take account of with regards to flood risk include the Greater Manchester Green Infrastructure Scoping Study 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 areas on the Irwell upstream of Salford that have a building density of less than 1.25%. This correlates with the Irwell CFMP findings on potential for storage in the catchment. However, the CFMP also concluded that proposed flood storage areas too high in the catchment would have little impact on reducing flood risk Salford. However, it is nonetheless 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.

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.

Waste and hazardous substances can also be released by flooding and potentially introduce harmful and polluting substances into flood waters for transport and distribution elsewhere. The Greater Manchester Waste DPD is currently being undertaken and identifies current and future areas for waste management, storage and transfer. Using this in conjunction with the SFRA may help to reduce the risk of flooding to waste sites. The SFRA should also be used to identify mitigation options for current waste sites within the region so that existing risks of contaminant release can be reduced.

6.3.4. Strategic Effects of Defence failure

As highlighted above, the residual risk of defence failure has already been identified in the original Salford City SFRA. Impacts include fast flowing, deep water through the Lower Kersal and Lower Broughton Areas. Both of these areas form part of the “Arc of Opportunity” for the sub-region and the Central Salford development area. Floodplain defence failure may actually increase the storage capacity within Salford and therefore reduce the impact of a flood event further downstream. However, the failure of flood storage schemes within the district (in particular the

Littleton Road Storage Basin) during a flood event would not only pose a serious flood risk to within Salford, but also increase peak flows to downstream areas.

6.3.5. Identifiable strategic mitigation options

Strategic options for mitigation include upstream flood storage 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. Similarly, locating storage facilities too low in the catchment may also have limited benefits and be difficult to locate due to the lack of suitable locations (in terms of topography, urban extent and available land). 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.

The Salford SFRA and the Irwell CFMP both identify that the creation of flood storage areas higher upstream in the Irwell catchment in Bury, Rochdale or Bolton would have limited benefits in Salford in terms of reducing flows and damages. However, both the CFMP and the SFRA recognise that the provision of an additional storage basin just upstream between Salford and Bury could have significant flood risk benefits. The 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 impact on reducing flood risk in Salford. 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.

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

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 Salford, Manchester and Trafford, infiltration SuDS are likely to be most suitable for new development, however the risk of contaminating the underlying aquifers needs to be seriously considered.

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

Salford_Overview/01

Salford_Overview/02

Salford_Overview/03

7. Stockport Metropolitan Borough Council

7.1. Stockport Development and Planning Context

The Borough of Stockport is home to a population of 284,528 people and covers a land area of approximately 12,950 ha. Bordering Manchester to the north and west, Tameside to the northeast and the Peak District National Park to the south and east, the District is situated in the southeast of the Greater Manchester conurbation at the junction of the Cheshire plain and the Pennine foothills. Approximately four-fifths of the population reside in the urban western part of the District.

Stockport has a diverse economy, defined by the decline of traditional industries and the growth of office based service sector businesses, computer software companies and financial services. Despite such growth Stockport is a District of economic disparity. Whilst suburbs such as Woodford, Bramhall and Hazel Grove rank amongst the most economically prosperous in the United Kingdom, districts such as Adswood and Brinnington continue to suffer from social deprivation and post-industrial economic decline. A map presenting planning information for Stockport is included at the end of this section (Figure Stockport Overview/02).

7.1.1. Strategic and Regional Position

Stockport MBC is one of the Authorities that make up the southern Manchester / Northeast Cheshire part of the Manchester City Region in the draft RSS and therefore relates to the other Authorities in this grouping, particularly neighbouring Macclesfied to the south. Stockport also has a close spatial relationship with the City of Manchester, particularly in the south part of the City but also as a key gateway into the central part of the City. Stockport also forms a key gateway into and out of Greater Manchester, providing the main access to / from the southeast into Derbyshire and the Peak District National Park.

7.1.2. Local Development Framework

Timetable

Stockport's Local Development Scheme (LDS) sets out the timetable for the development of their Local Development Framework (LDF). The Core Spatial Strategy is currently at the Issues & Options stage and issues are being consulted on in the near future. The Site Allocations DPD is at a very early stage in preparation, as is the Town Centre Area Action Plan (AAP). All the Greater Manchester Authorities are preparing a Joint Waste DPD, which will be at the 2nd stage Issues & Options Paper in January 2008. The Stockport LDS sets out 3 new Supplementary Planning Documents (SPDs) and saves a further 7 SPGs. The 3 new SPDs will all be adopted by the end of 2007. The Stockport UDP was adopted in 2006 and has been saved until incrementally replaced by the various elements of the LDF.

Regeneration Activity

Stockport, or locations within Stockport, are not part of any national regeneration programmes, however, the District has focused efforts on the regeneration of the Town Centre and key strategic areas that front onto the M60 route through the District. To this end the Town Centre Master plan sets out a 20 year strategic vision for the Town Centre in which it seeks to stimulate residential and commercial development activity.

Housing Land

The replacement draft Regional Spatial Strategy 2006 specifies that an additional 450 dwelling should be provided per annum. The Council supports this figure given the estimated level of development schemes to come forward over the life of the plan period.

Table 7-1: Stockport MBC Regional Spatial Strategy Targets - 2003 – 2021

	Target
Overall Housing Increase 2003-21	8,100
Mean Annual Increase	450
Indicative Previously Developed Land	80%

The Council can identify broadly where future housing land supply is likely to come from and when set against the RSS targets is confident that the targets will be met and exceeded. By and large, these are sited within developments that have already gained planning permission or are within the planning pipeline of development sites yet to come on stream. The Council also anticipate further housing to come forward as a result of mixed-use development within the Town Centre. A town centre master plan has been prepared to guide development over the next 20 years.

The Housing Supply Trajectories can be drawn from the Chart below (Figure 7-1, AMR 2006, p.26) which shows net completions by financial year to 2005/06 and projected net completions until the year 2010/11. Although this chart does not overlay the proposed draft RSS target for new dwellings (net clearance development) it can be seen that, in general, over the period 2003-11 very few years have, or are projected to, reach the 450 unit target. In order to manage this under supply in the early years of the RSS period, more than the annual target of 450 units will need to be developed after 2011 and so appropriate sites will need to be identified for this provision.

Employment Land

In January 2005, employment land availability schedules identified around 86 hectares for industrial or business development in the District. The Council's current target for employment land is 6 ha per year, meaning that the District has identified enough employment land to allow development until 2019. The Council is seeking to build upon the strategic asset of the Stockport M60 Gateway. Tiviot Way in Portwood, a 5.7 hectare former industrial works, occupies a pivotal position within the M60 corridor and has been designated as an opportunity for a major employment generating scheme. Outline planning permission for a major retail development has been submitted on the site. Also included in the total for employment land availability is a 2.4

hectare site at Cheadle Royal Hospital, which has been allocated for the development of a high quality business park and a new Employment Area has also been proposed on a 6.9 hectare site at Gorsey Bank.

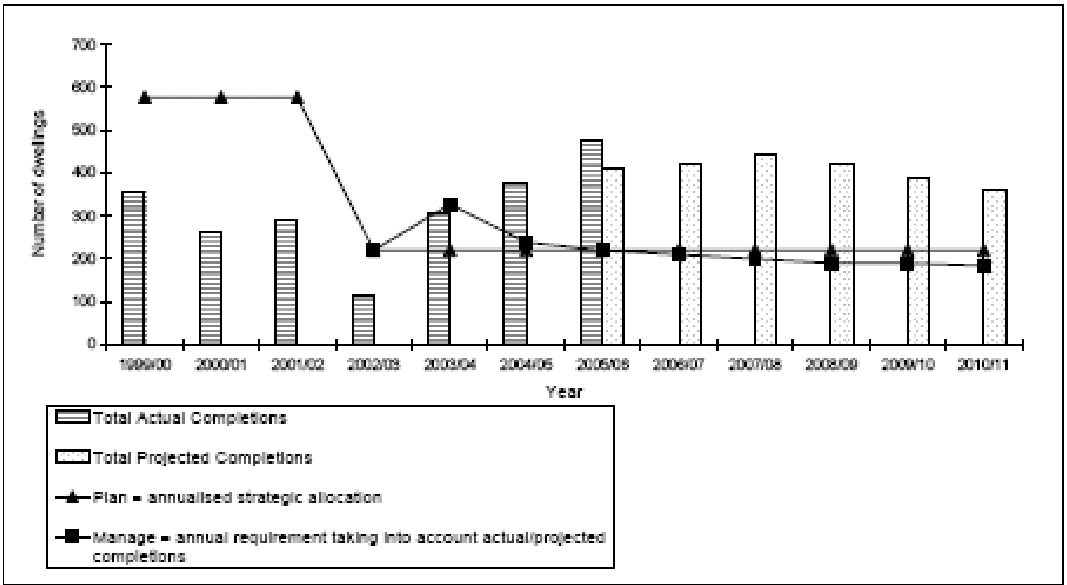


Figure 7-1: Housing Trajectories for Stockport MBC

Transport Infrastructure

Stockport is well-served by public transport and in terms of strategic road corridors. The M60 and the A560 provide east-west strategic road corridors through the District, while the A6 provides a north-south strategic road corridor, linking Stockport northwards to Manchester City Centre. The M60 provides easy connections for the District to the rest of Greater Manchester, to the rest of the northwest and to the M56 and M62.

Stockport Council, Cheshire Council and Manchester City Council have started work on developing the SEMMMS New Relief Road Scheme. This scheme includes the Stockport North – South and Poynton bypasses and the Manchester Airport Link Road West. The Authority are proposing to introduce Metrolink to East Didsbury (and from there the Airport, Altrincham and Manchester City Centre, among other destinations).

7.2. Stockport Flood Risk Summary

7.2.1. Hydrological background: catchment and watercourse network

The District of Stockport lies within the Greater Manchester SFRA area. The District is situated mostly in the middle and upper reaches of the Bollin and Micker Brook in the south of the District, Etherow and Tame in the north of the District, the Goyt and Sett in the East of the District, and the Mersey through the centre of the District. All of these watercourses carry with them an inherent potential flood risk. The middle reaches have flatter and lower topography, and the lower reaches of watercourses tend to have lower and flatter topography still, and flooding can be spread over a larger area than in the steeper and more confined floodplains of the upper catchment. The main urban areas at greatest risk from flooding in the District are Stockport, Cheadle and Marple Bridge. The draft Upper Mersey Estuary CFMP covers the District and provides a catchment wide assessment of flood risk, and can be used as a tool to aid planners strive towards sustainable development. A map presenting flood risk information for Stockport is included at the end of this section (Figure Stockport Overview/01). Table 7-2 shows the main watercourses and urban areas at risk of flooding from each.

Table 7-2: Watercourse and Urban Area at Risk in Stockport MBC

Main Watercourses	Urban area at risk
Dean	Handforth
Etherow	Woolley Bridge,
Goyt	Stockport, Romley, Marple, Marple Bridge
Mersey	Stockport, Cheadle
Micker Brook	Cheadle
Tame	Stockport, Reddish, Cheadle

7.2.2. Historical Flooding

A review of the information supplied by the council, the EA, CFMP's, and through searching online historical records[39], has revealed that Stockport has experienced a number of flood events throughout the last century. Historically the District has experienced river flooding predominantly from the Mersey, Goyt, and Bollin, and surface water and sewer flooding from localised intense rainfall events. The historic records of flooding show that the District is vulnerable to both periods of prolonged rainfall in the autumn and winter months mainly leading to fluvial flooding, and local flash flooding primarily of surface water caused by intense summer downpours (Table 7-3).

British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe [39]

Table 7-3: Significant Historic Flood Events in Stockport MBC

Date	Location	Source of flooding	Impact	Source of information
November 1890	Cheadle, Goyt	Prolonged heavy rainfall	Local flooding	BHS Database
December 1965	Mersey: Stockport, Tame, Goyt: Cheadle	Torrential rainfall	Livestock killed, flooded property and evacuations Sewers burst	Upper Mersey CFMP
July 1970	Brinnington	Heavy Rainfall	Gardens flooded	BHS Database
March 1998	Cheadle	Heavy rainfall	Land and property flooded	Upper Mersey CFMP
October 1998	Rivers Bollin and Dean, Cheadle	Prolonged rainfall	Severe flooding Return Period 1:100	Upper Mersey CFMP
February 2001	Gatley	Heavy Rainfall/Overland flow	Flooded Gardens	Stockport Express
June 2001	Marple Bridge	Intense rainfall	Localised flash flooding	Stockport Express
July 2006	Bredbury	Intense rainfall	Localised flash flooding	Stockport Express

7.2.3. CFMP Assessment of Flood Risk

The District is covered by the draft Upper Mersey CFMP. Draft policies are subject to change and the SFRA must be adapted accordingly. CFMP's have split overall flood risk in the District into the six units displayed in Table 7-4. The River Irwell and Mersey Estuary CFMPs have assessed the level of flood risk in each of the policy units defined within them, as being high, medium or low, and this is also displayed in Table 7-4. The CFMPs have also recommended a preferred policy option number for each unit. The generic policy options are shown in Table 7-5.

Table 7-4: Policy units and preferred policy for Stockport MBC

Policy Unit	Policy Option	CFMP	Risk
PU2 Bollin	3	Upper Mersey	Low
PU3 Tame	5	Upper Mersey	High
PU4 Mersey	5	Upper Mersey	High
PU6 Goyt	5	Upper Mersey	High
PU7 Etherow	3	Upper Mersey	Low
PU8 Outliers	4	Upper Mersey	Low

Table 7-5: Generic CFMP Policy

Policy 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)

7.2.4. Current and Future Flood Risk in Stockport MBC

Identification of Flood sources

Flooding from Rivers

The historic flood event search, the EA, the City Council, and the CFMP all suggest that one of the main flood risks within the District is flooding from rivers. Flood risk is highest in the steeper areas in the upper catchment sections such as Marple Bridge. The upper reaches are susceptible to short-term intense rainfall events such as thunderstorm activity where large volumes of water are confined to relatively narrow river valleys. The lower reaches of rivers in the catchment tend to be at risk from fluvial flooding attributed to prolonged rainfall activity as the naturally flatter topography drains a larger catchment area. Areas surrounding confluences of tributaries and main channels such as Stockport at the confluence of the Tame and Goyt have an increased flood risk, particularly if flood peaks on both watercourses coincide or flow exceeds culvert capacity. The main flood risk areas in the District are Stockport, Micker Brook in Cheadle, Heaton Mersey and Gatley Brook in Gatley. Flooding due to flow restrictions, which can be attributed to sedimentation and blockage of structures and weirs, is a risk. This type of flooding is primarily found upstream of structures when water backs up behind the blockage and ultimately overtops the channel.

Whilst fluvial flooding poses a significant to the District, 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.

Flooding from the Land

During periods of prolonged rainfall events and sudden intense downpours, overland flow from adjacent 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. 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.

The historical records, CFMP, Stockport MBC and the EA have all confirmed flood events as a result of surface water / pluvial flooding in the past.

Flooding from Sewers

Sewer flooding is another flood risk throughout the District, 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 the watercourse. The water then backs up and will again start to discharge. Sewer flooding was identified using historical records from United Utilities DG5 database (June 2007) detailing the total number of flood events that affected both internal and external property. Sewer flooding is known to have occurred in Stockport and Bredbury.

It should be noted that much of the sewer network is thought to date 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 the WRC "Sewers for Adoption"[40] 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 this design standard is not achieved. It is therefore likely that much 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.

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) (Figure 7-2) 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 that is also covered by the Data Protection Act (1998). As a result, a detailed analysis of the scale and consequences of sewer flooding has not been possible at this stage of the SFRA.

[40] Sewers for Adoption, Wrc Publications 2006

However, 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 and AGMA have agreed to share data on drainage and development areas initially for Bury and Salford. This will allow both UU and AGMA to determine the usefulness of the data and to agree how it can be spatially represented on a sub-regional and strategic basis for the whole of the AGMA area. It is anticipated that both UU and AGMA will have agreed the scale and format of the data in time for more detailed Level 2 assessments.

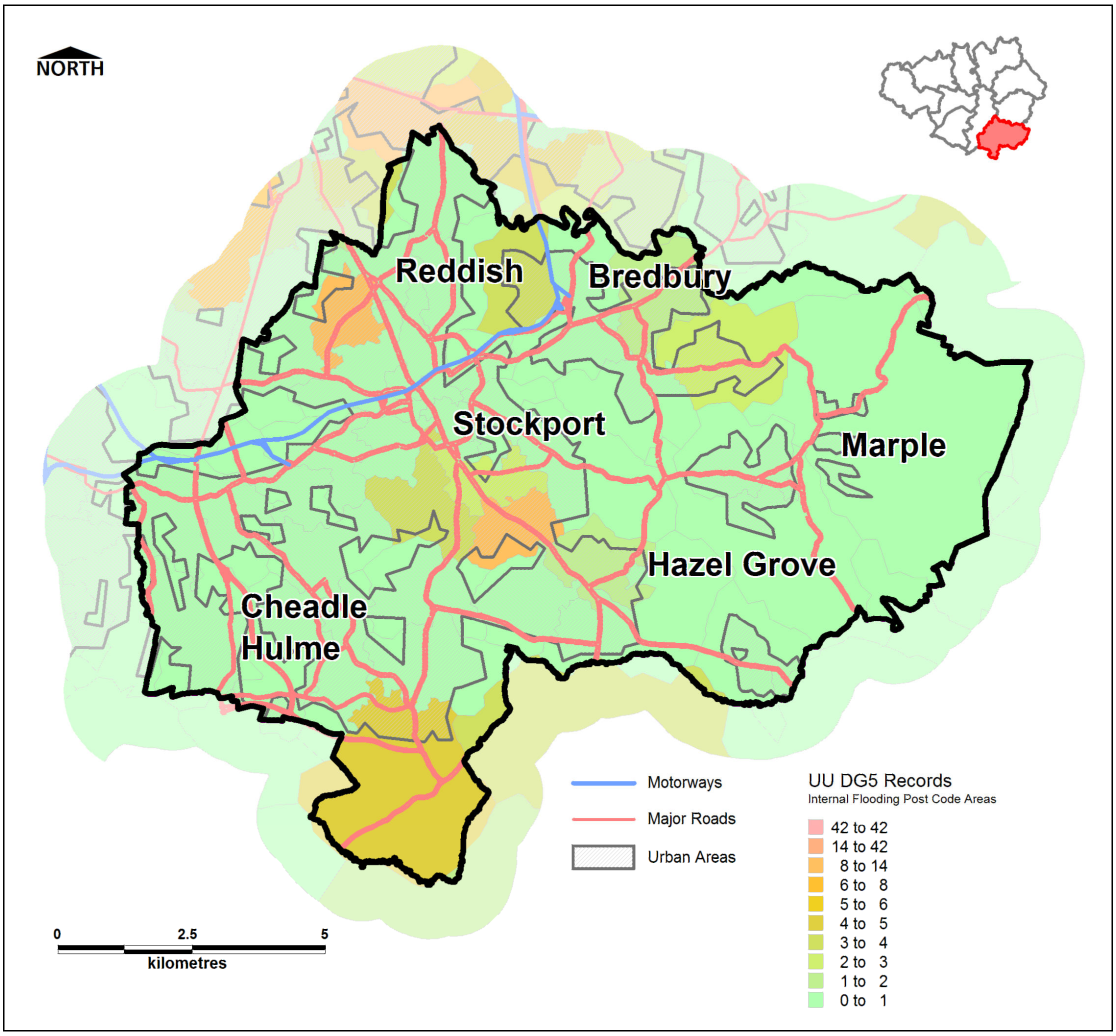


Figure 7-2: UU DG5 data (June 2007) showing instances of Internal Flooding by five-digit postcode area for Stockport MBC.

Flooding from Reservoirs, Canals and Other Artificial Sources

There are a number of reservoirs upstream of the District. Reservoirs have an attenuating effect on flood flows and can be used to control flows. Reservoirs do however have a flood risk associated with them in terms of dam/reservoir wall failure and emergency releases into the catchment. The likelihood of this occurring is minimal but impacts are potentially extremely high due to the limited warning time available and the potential high velocity and high volume flows.

The Peak Forest and Macclesfield Canals run through the south and west of the District to their junction in Marple, from where the Peak Forest Canals continues north into Tameside District. 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 remains where water levels could overtop or breach embanked sections.

Flooding from Groundwater

British Geological Survey (BGS) Maps show the MCC area to be underlain by more permeable rocks consisting primarily of mudstones, siltstones and sandstones. As a result, the EAs groundwater vulnerability maps show that approximately half the District is classified as major aquifer, consisting primarily of the Permo-Triassic Sandstone Aquifer, with higher permeability, particularly around the Stockport and Marple area.

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 have revealed no reported incidents of groundwater flooding in Stockport MBC. However, work undertaken by the EA recently[41] has suggested that the cessation of mine dewatering and the slowing of abstraction from the aquifers, has led to an increase in groundwater levels, or groundwater rebound.

According to the EAs water resources team and groundwater monitoring undertaken in the area, the risk posed by groundwater flooding is likely to remain remote. However, this could become more of an issue in certain areas due to the rising groundwater levels in the major aquifer – especially those in river valleys and next to canals, where local groundwater levels may be influenced by the river and canal.

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

The impacts of increased development in these areas must therefore 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. Deep excavations for new development (for example, underground car parks and basements, or new infrastructure tunnels) should be carefully assessed to determine what risk is posed.

Fluvial Flood Zones

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 and each outline used to create the SFRA flood zones assumes that no defences exist. There are no areas of tidal flood risk within the AGMA sub-region.

However, there are areas where little or no accurate flood outlines exist, and therefore, to ensure a continuous coverage across a flood zone, less accurate, broad-scale modelled (the EA J-FLOW Flood Zones) outlines were used instead. This hybrid approach provides a conservative flood zone and highlights potential uncertainties that can either be resolved in more detail at Level 2, or by developers as part of site-specific FRAs. The SFRA has identified the following flood zones in accordance with PPS25:

Flood Zone 1: Low Probability of Flooding
Land having a less than 1 in 1000 annual probability of river 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%) in any year. No detailed modelled outlines exist for Flood Zone 2 in the Stockport MBC area. Therefore, the EA broad-scale Flood Zone 2 maps were used.

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

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. Where possible, 1:20 or 1:25 year detailed modelled outlines were used to define the functional floodplain. Some defended areas may include flood storage basins which are by their very nature functional floodplain. 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 in the data and potential tasks for the more detailed Level 2 assessments. 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.

Using the Flood Zone maps, the total area of Salford at risk of fluvial flooding can be determined. Table 7-6 and Figure A-5 (Appendix A) show that areas of the district are at risk of fluvial flooding, with approximately 7.5% of the district area affected by Flood Zones 2 and 3.

Table 7-6: Area of Fluvial Flood Risk to Stockport MBC

District Area (ha)	Urban Area (ha)	Fluvial Flood Zone	Area (ha)	% (of District or Urban Area)
12,565.30	5,765.29	FZ3b	286.67	2.28
		FZ3a	337.54	2.69
		FZ3 in Urban	104.60	1.81
		FZ3 + CC	289.84	2.31
		FZ2	300.60	2.39
		FZ2 in Urban	148.55	2.58

Note: Figures for FZ3a refer to the area outside of FZ3b, figures for FZ3+CC and FZ2 refer to the area outside of FZ3a.

Flood Zone Confidence

Flood Zone Confidence Maps are intended to be used by planners as a tool for identifying areas of high, medium or low confidence in the data that has been used to derive fluvial Flood Zones across the sub-region and also to determine where further work is required. The confidence assigned to a Flood Zone demonstrates the level of detail and the number of assumptions made when deriving the Flood Zones. The maps can be used to determine reaches of river where further, more detailed work is required to refine Flood Zones and therefore where resources should be directed.

Table 7-7 illustrates the confidence assigned to the Flood Zones present within the Stockport MBC district. A map showing confidence in the each of the Flood Zones is presented at the end of this section (Figure Stockport Overview/03).

Table 7-7: Fluvial Flood Risk Confidence for Stockport MBC

District	Fluvial Flood Zone	Watercourse	Settlement	Source	Date of Modelling Study	Confidence
Stockport	3b	All Other Watercourses	Gatley	EA Flood Zone Maps	NA (May 2008)	Low
			Cheadle			
			Bramhall			
			Stockport			
		Micker Brook	Bramhall	Micker Brook	2005 (May 2008)	High
			Cheadle			
		Chor	Cheadle	Chorlton SFRM Chor	2008 (May 2008)	High
		Cringle	Reddish	Chorlton SFRM Cringle	2008 (May 2008)	High
		Poise Brook	Hazel Grove	Poise Model	2005 (May 2008)	High
	3a	All Other Watercourses	Gatley	EA Flood Zone Maps	NA	Medium
			Cheadle			
			Bramhall			
			Stockport			
		Micker Brook	Bramhall	Micker Brook	2005	High
			Cheadle			
		Poise Brook	Hazel Grove	Poise	2005	High
		Chor	Cheadle	Chorlton SFRM: Chor	2008	High
		Cringle	Reddish	Chorlton SFRM: Cringle	2008	High
	3a + CC	Cringle Brook	Reddish	Chorlton SFRM: Cringle	2008	High
		All Other Watercourses	Marple	EA Flood Zone Maps - Flood Zone 2	NA	Low
			Stockport			
			Cheadle			
		River Chor	Cheadle	Chorlton SFRM: Chor	2008	High
	2	All Other Watercourses	Gatley	EA Flood Zone Maps	NA	Medium
			Cheadle			
			Bramhall			
			Stockport			
		Chor	Cheadle	Chorlton SFRM: Chor	2008	High
		Cringle	Reddish	Chorlton SFRM: Cringle	2008	High

Climate Change and Future Flood Risk

The CFMP's have 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 District. Defra/UKCIP (United Kingdom Climate Impacts Programme) 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.

Stockport has been shown to be at a very high risk of increased flooding under climate change and urban impact scenarios.

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)[42] 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 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. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

The location of future urban developments and flood defences within a catchment can influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments. It may however be possible to mitigate against this 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.

To account for Climate Change at the sub-regional level, 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 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 Level 2 SFRA stage or during site-specific FRA’s (developer-led).

Flood Risk Mitigation and Management

Flood Risk Management

Flood risk management assets may be hard formal structures designed for purpose such as flood walls, or they may be informal structures such as garden walls which were not designed specifically as defence structures, but are now performing that role. The National Flood and Coastal Defence Database (NFCDD) identifies any asset (including channels) that may have an impact on flood risk management and is constantly being updated and amended by the EA as a

[42] 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

result of ongoing asset inspections. It should be noted that the database assigns a Standard of Protection (SoP) to flood defence assets and has a default value of 50 Years. Therefore the SoP values should be treated with caution and assessed (in conjunction with the EA) on a site-by-site basis during the more detailed Level 2 assessments. NFCDD data, along with CFMP's and council supplied information, have been used to identify major structures and flood defences assets in the District.

By interrogating NFCDD outputs, a series of informative statistics about flood risk assets can be obtained. For Stockport MBC, data from NFCDD shows that there are over 7km of culverted watercourse and over 5.5km of man made raised flood defences, 3.24km of which have a SoP of between 21 and 50 years (Table 7-8).

Table 7-8: NFCDD data summarising lengths of flood defence asset in the Stockport MBC Area (km) by Standard of Protection (return period in years).

Asset Type	Length of FRM Asset (km) by Standard of Protection in years					
	Unclassified	**0-20**	**21-50**	**51-75**	**76-100**	**Total**
Culverted Channel	0	0.07	6.65	0.27	0.34	7.34
Maintained Channel	0	0.00	0.13	0.00	0.00	0.13
Natural Channel	0	1.52	34.32	7.26	1.61	44.70
Flood Defence Structure	0	0.86	99.16	25.26	2.24	127.52
Non-Flood Defence Structure	0	0.03	0.46	0.06	0.00	0.55
Raised Defence (Man-Made)	0	1.27	3.24	1.04	0.00	5.54
Total	**0**	**3.75**	**143.9**	**33.90**	**4.18**	**185.79**

Mitigation

There are many different types of flood risk mitigation actions ranging from small, single dwelling flood proofing measures to flood warning services to large multi-million pound flood defence schemes.

There are flood warning areas on the Mersey covering the Cheadle area that have been an effective mitigation measure for many years. However, flood warnings tend to work most effectively during large events with long lead times so that sufficient advance notice is given to residents and businesses and are usually only applicable to fluvial flooding. In the case of intense, flashy rainfall events, where pluvial and sewer flooding may pose the most risk, flood warnings schemes rarely exist.

The CFMP for the Upper Mersey[43] suggests implementing washland areas on the Mersey at the confluence of the Tame and Goyt, at Goyt Hall Farm, Marple Dale, and Brabyns Park at the confluence with the Goyt and Etherow. These washlands can potentially attenuate peak flood flows.

[43] Draft Upper Mersey CFMP February 2007

Risk of Failure of Defences and Impacts

Behind defended areas there is a residual risk of 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 tend to be low lying, and the water level will have often built up to a higher level than ground levels of the defended area.

People and Property at risk of flooding

The EA carried out a strategic review of flood risk for the whole of the North West Region[44]. This looked at the EA Flood Zones and the number of properties at risk of flooding within each District in the North West. Table 7-9 shows the number of properties at risk of flooding in each flood zone.

Table 7-9: Properties at risk of flooding (source: EA Flood Zone Ranking using EA Flood Zones)

FZ3	FZ2&3	FZ1	Total
3,399	4,456	126,614	131,070

The Upper Mersey CFMP also looked at the number of properties at risk of flooding on watercourses in the catchment and these are shown in Table 7-10.

Table 7-10: Properties at risk by type and watercourse for Stockport MBC

Watercourse	Total	Residential	Employment	District
Bollin	150	128	22	Stockport, Trafford, Manchester
Dean	100	96	4	Stockport, Trafford, Manchester
Tame	1004	548	456	Tameside, Oldham, Stockport
Micker Brook	895	834	61	Stockport
Mersey	1529	1339	190	Stockport, Manchester, Heaton Mersey, Trafford
Goyt	208	117	91	Stockport
Etherow	113	50	63	Tameside, Stockport

Using census Output Area (OA) data (the smallest census geographical area), and updated mid-term 2005 population estimates for Stockport, the potential populations affected by flooding in the different flood zones are presented in Table 7-11. 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 a district, 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

[44] 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)

a CO by the type of accommodation they live in. Again, assuming an even distribution across a CO, an indication as to the predominant types of properties at risk can be shown

Table 7-11: Approximate number of people affected by fluvial flooding in Stockport

	Population at Risk (2005)	People living in House Bungalow	People living in Flat or Apartment	People living in Caravans or moveable Accommodation	People living in Shared Dwelling
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

7.3. Strategic Overview of Flood Risk for Stockport MBC

7.3.1. Consequences of Upstream and Downstream Development

Broad development upstream of Stockport within the Dean, Mersey, Etherow, Tame, Goyt and Micker Brook catchments is defined within the RSS in terms of housing figures. The four districts upstream that are connected to Stockport hydrologically therefore have the potential to adversely affect the current flood risk in Stockport. As the district is located towards the upstream extent of the catchments there is potential for development both within and adjacent to, the AGMA sub-region to affect flood risk in Stockport. 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.

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.

Should RSS housing targets be met, for example, a total of 31,400 new homes will be built in districts upstream of Stockport with 109,040 new homes downstream of the District (Figure 7-3). These figures are for net new housing and so are additional to the current levels of development. Furthermore, all of the districts within the AGMA sub-region have a high target for development on previously developed land (PDL). As a result, if no measures are taken to control runoff from new development, there is the potential for an increase in flood risk to Stockport. In reality, however, it is likely that much of the new development will be constructed to modern and sustainable standards incorporating, where possible, SuDS to limit runoff.

Downstream and adjacent to Stockport are Salford CC, Manchester CC, Trafford MBC, and Warrington MBC. Within the draft RSS, Stockport is not highlighted as a location for any key regionally strategic sites, however, development in Stockport has the potential to impact on the flood risk of downstream and adjacent districts. As identified by the CFMP, Stockport contains potential floodplain storage areas (for example washland areas on the Mersey at the confluence of the Tame and Goyt, at Goyt Hall Farm, Marple Dale, and Brabyns Park at the confluence with the Etherow, and on the Tame just south of Woodhouse Farm). However, to avoid reducing floodplain storage and potentially increasing flood risk downstream, development within and adjacent to these areas must be undertaken carefully so as not to adversely affect flood storage or flood flow routes. In addition, the incorporation of green open spaces and SuDS measures may help to reduce increased runoff.

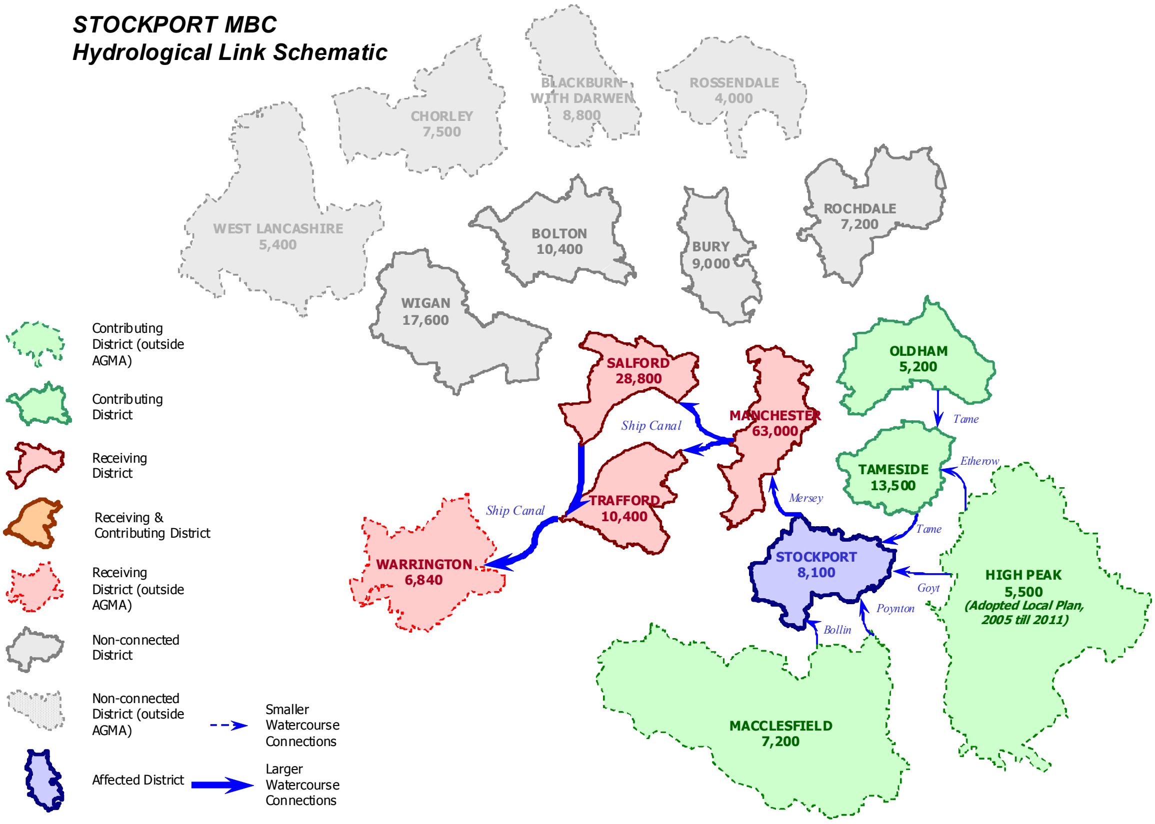


Figure 7-3: Hydrological Links for Stockport MBC

7.3.2. Potential Conflicts between broad development aspirations and the PPS25 Sequential Test

As highlighted above, the current flood risk to the district is primarily from fluvial sources, in particular the River Mersey, though most records refer to pluvial and sewer flooding. In addition, there is, at present, an unquantified risk of flooding from the Peak Forest and Macclesfield Canals. Most of the potential development locations are situated outside of the main flood zones, however, there are areas of potential development, particularly to the north of Stockport that lie within flood zones 2 and 3.

There are some ambitious aspirational infrastructure schemes planned within the district 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 Borough Council. 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.

Most of the proposed development areas, include some of the most densely populated areas in Stockport. Therefore, there is potential for an increase in the amount of impermeable area and the subsequent increases in runoff and the impacts on surface water and sewer flooding. Using UU data and the Urban Morphology Types (UMT) boundaries from the ASSCUE project the percentage of impermeable areas within the district can be identified and it is recommended that the risks associated with potential surface water (pluvial) and sewer flooding in these areas is examined in more detail at the Level 2 SFRA stage.

As a result, potential conflicts exist between development and the PPS25 Sequential Test in these areas. In order to examine these in more detail, it will be necessary to create maps showing more detailed flood outlines taking into account functional floodplain and climate change (as per PPS25 requirements) and displaying the risk associated with the Peak Forest and Macclesfield Canal during a Level 2 assessment.

7.3.3. Impacts on and from other strategic spatial considerations

Other spatial considerations that Stockport MBC should take account of with regards to flood risk include the Greater Manchester Green Infrastructure Scoping Study 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. It is important that such 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.

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.

Waste and hazardous substances can also be affected by flooding and potentially introduce harmful and polluting substances into flood waters for transport and distribution elsewhere. The Greater Manchester Waste DPD is currently being undertaken and identifies current and future areas for waste management, storage and transfer. Using this in conjunction with the SFRA may help to reduce the risk of flooding to waste sites.

7.3.4. Strategic Effects of Defence failure

Impacts of defence failure include fast flowing, deep water which has the potential to cause major damage and loss of life within the District. At this time, it is not thought that the impacts of defence failure in Stockport will adversely impact on districts downstream.

7.3.5. Identifiable strategic mitigation options

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. Similarly, locating storage facilities too low in the catchment may also have limited benefits and be difficult to locate due to the lack of suitable locations (in terms of topography, urban extent and available land). 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

In the Tame, Goyt and Mersey Policy Units (Pus 3-6) presented in the Draft Upper Mersey CFMP[45], 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 Tameside and Stockport. However, 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 Stockport, they provide benefits to all districts downstream especially to the regional centre and strategically important regional development areas in Manchester and Trafford.. 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 catchment is reduced. Furthermore, and working closely with the outputs from the current sub-regional Green Infrastructure study, careful landuse

[45] Draft Upper Mersey CFMP February 2007

planning and the gradual reinstatement of green open spaces together with wetlands and woodlands throughout the catchment may help to further reduce runoff.

Stockport_Overview/01

Stockport_Overview/02

Stockport_Overview/03

8. Tameside Metropolitan Borough Council

8.1. Tameside Development and Planning Context

Tameside Metropolitan Borough is located on the east of the Greater Manchester conurbation and is just over 10,300 ha in size with a resident population of 214,100 and 95,945 households (AMR 2006). Given that the District has distinct urban and rural areas, there is a wide variation in population density. The District comprises the towns / urban areas of Ashton-under-Lyne, Hyde, Denton, Audenshaw, Dukinfield, Droylsden, Stalybridge, Mossley and Hattersley. Tameside is also directly west of the Peak District National Park and provides the main entrance point from Greater Manchester into northern parts of the Peak District, with routes continuing across to South Yorkshire. A map presenting planning information for Tameside is included at the end of this section (Figure Tameside Overview/02).

8.1.1. Strategic and Regional Position

Tameside MBC is one of the Authorities that make up the Pennine part of the Manchester City Region in the draft RSS and therefore relates to the other Authorities in this grouping, particularly neighbouring Oldham but also to neighbouring Stockport in the southern Manchester part of the city region. Tameside also forms a key gateway into and out of Greater Manchester with the A57 / M67 going through the District between Manchester City Centre and the Peak District. As such, the District also relates closely with Manchester City Centre and East Manchester (with its areas of significant regeneration and the Sports City area) as well as High Peak District Council to the east. Within the draft RSS, Tameside is not highlighted as a location for any key regionally strategic sites, however the Ashton Moss development is considered as such by the Tameside UDP and is certainly a highly significant development for the eastern part of Greater Manchester.

8.1.2. Local Development Framework

Timetable

Tameside's Local Development Scheme (LDS) sets out the timetable for the development of their Local Development Framework (LDF). The Core Spatial Strategy is currently at the Issues & Options preparation stage and scheduled for adoption in 2010. Five Supplementary Planning Documents (SPDs) were complete by the end of 2007. Despite delays, a further four SPDs should be adopted by the end of 2008. Preparation of the Site Allocations DPD will not begin until 2009. All the Greater Manchester Authorities are preparing a Joint Waste DPD, the Stage 2 Issues & Options Report has recently been delayed until about June 2008. The Tameside UDP (2004) has been saved as statutory planning policy for Tameside until the LDF is complete.

Regeneration Activity

The Authority has received in excess of £10 million in Neighbourhood Renewal Fund allocations since 2001, funding which is to be used to narrow the gap between deprived areas / communities and the rest of society. Hattersley has been the subject of much regeneration activity in recent times and the Ashton Moss development is helping to rejuvenate the economy of the District.

Housing Land

The annual average rate of housing provision (net of clearance) is set at 370 in the Tameside UDP (policy H1), but the figure proposed in the draft Regional Spatial Strategy (RSS) is 750 dwellings per annum, a figure unchanged by the Panel Review recommendations.

Table 8-1: Housing Targets

	Draft RSS Target
Overall Housing Increase 2003-21	13,500
Mean Annual Increase	750
Indicative Previously Developed Land	80%

The Housing Supply Trajectories can be drawn from the Chart below (Figure 8-1, AMR 2006, p.13) which shows net completions by financial year to 2005/06 and projected net completions until the year 2014/15 and then overlays the proposed annual housing requirement from the draft RSS (750 units). As can be seen, in general, recent years have seen an under-supply of housing in comparison to the draft target but from 2007/08 onwards projected figures will exceed this target, meaning that the RSS requirement will be met by 2013, and will continue to be met for the remainder of the trajectory period i.e. until 2015 at least.

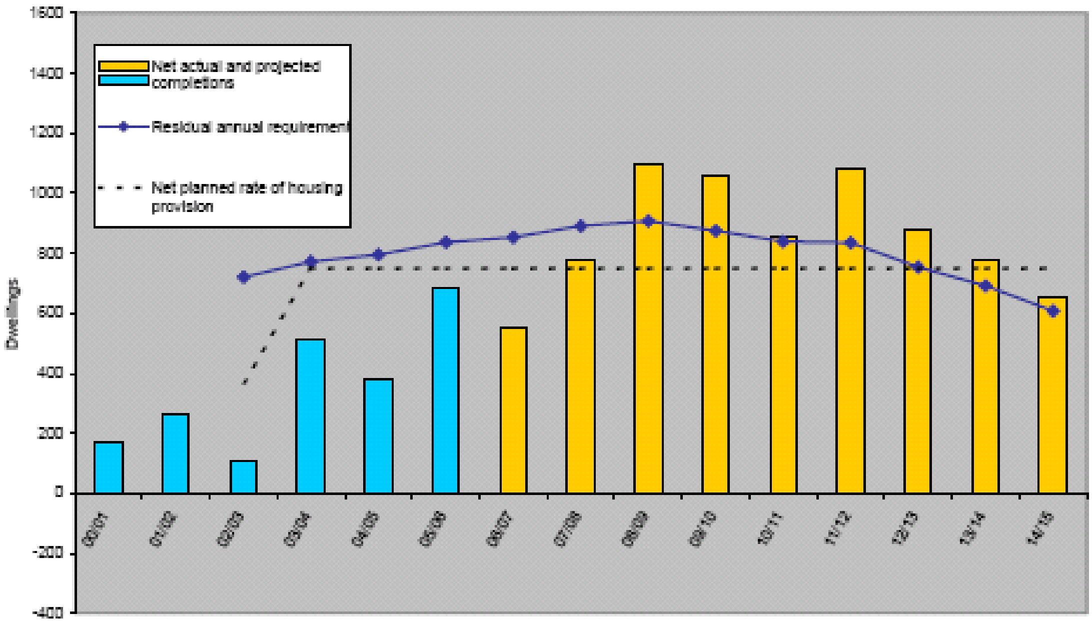


Figure 8-1: Housing Supply Trajectories for Tameside MBC

The distribution of this forecast across the 10 year timescale shows key regeneration schemes coming forward in the middle years but then the forecast completion rate tailing off towards the end because sites are not identified so far ahead. The UDP identified a housing land supply for 5,101 net additional dwellings (April 2003) and while figures in 2007 show 4,059 net additional dwellings in the planning pipeline and 2,446 net additional dwellings under construction, indicating that more sites have been found since 2003, at this time, it is difficult to identify what sites will come forward post-2015 that will allow Tameside to meet the draft RSS target.

Employment Land

The total supply of land available for development for employment purposes in Tameside in March 2006 was 83 ha (AMR, 2006, p.6). This is a decrease on the previous year's supply of 92 ha. This current supply figure consists of vacant sites that are allocated for employment use, or have permission for employment generating development, and non-vacant sites that have permission for redevelopment for employment purposes.

The inclusion of a site in the available supply does not indicate any intentions of the owner(s) to sell the site or otherwise make it available for development. However, of the 83 ha available, 31 ha was classed as 'immediately available'. The sites in the immediately available supply were listed on the MIDAS database and for sale on the open market.

A breakdown of the different types of employment land in the available supply is shown in Table 8-2.

Table 8-2 Employment Land Supply

Type	Amount Available
B1	8.99 ha
B2	13.80 ha
B8	1.62 ha
General	58.47 ha
Total	82.88 ha

Although take-up of employment sites has been slower in recent years, the demand for employment land remains high but while there are some high quality sites still available (e.g. remaining Ashton Moss plots) the long-term supply is limited and more land may need to be identified to keep up with demand.

A significant proportion of the District's workforce commutes out of the District to work, particularly to Manchester and this is likely to continue, so this factor needs to be taken into account when considering demand for employment land.

Transport Infrastructure

Tameside is well-served by public transport strategic road corridors. The A57 / M67 and the A635 provide east-west strategic road corridors through the District, west into Manchester and east into the Peak District, while the M60 and the A627 provides the north-south strategic road corridor, linking Tameside to Oldham and Stockport. The M60 also provides easy connections for Tameside to the rest of Greater Manchester, to the rest of the northwest, to West Yorkshire and to the M56 / M6 (and so Birmingham and London).

In terms of public transport, a metrolink extension is proposed, linking Ashton-under-Lyne to Manchester City Centre, via Droyslden, East Manchester and Sports City, and connections from there to the rest of Greater Manchester via public transport and to major towns and cities across the UK via the rail network. Existing rail and bus connections to Manchester, Oldham and Stockport are also good, predominantly via Ashton town centre.

Locally, Tameside's public transport is very good, with virtually all parts of the District being within 30 minutes on public transport to a GP / health centre, employment areas, primary and secondary schools and town or district retail centres. Access via public transport to a hospital is not so efficient, but it is still good.

8.2. Tameside Flood Risk Summary

8.2.1. Hydrological background: catchment and watercourse network

Tameside MBC lies within the Greater Manchester SFRA area. The District is situated in the upper and middle reaches of the Rivers Tame, Etherow and Medlock. Other watercourses within the District include the Huddersfield Narrow Canal, Manchester and Ashton-under-Lyne Canal, Peak Forest Canal, along with numerous smaller watercourses such as Lumb Clough. All of these watercourses carry with them an inherent potential flood risk. The upper reaches are susceptible to short-term intense rainfall events such as thunderstorm activity as water levels can build up in the steep, confined floodplains of the upper catchment. The middle reaches have flatter and lower topography than the upper catchment, and flooding can be spread over a larger area than in the steeper and more confined floodplains of the upper catchment.

The main urban areas at greatest risk from flooding in the District are Stalybridge, Denton, Ashton, Hollingworth, Dunkinfield and Mossley. The draft Upper Mersey CFMP covers the District and provides a catchment wide assessment of flood risk. The CFMP can be used as a tool to aid planners strive towards sustainable development. Table 8-3 shows the main watercourses and urban areas at risk of flooding from each.

Table 8-3: Watercourse and Urban Area at Risk in Tameside MBC

Main Watercourses	Urban area at risk
Etherow	Hollingworth
Tame	Stalybridge, Mossley
Medlock	Limehurst, Ashton, Droylsden, Mossley
Denton Brook	Denton
Johnson Brook	Dukinfield, Hyde

8.2.2. Historical Flooding

A review of the information supplied by the council, the EA, CFMP's, and through searching online historical records[46], has revealed that Tameside has experienced a number of flood events throughout the last century. Historically the District has experienced river flooding predominantly from the Tame and surface water and sewer flooding from localised intense rainfall events. The historic records of flooding show that the District is vulnerable to both periods of prolonged rainfall in the autumn and winter months mainly leading to fluvial flooding, and local flash flooding primarily of surface water caused by intense summer downpours. Table 8-4 shows a number of significant historical flood events.

[46] British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe

Table 8-4: Historic flooding

Date	Location	Source of flooding	Impact	Information source
Summer 1932	Longdendale Valley	Surface water	Inundation of property and land	BHS
December 1965	River Tame	Fluvial, sewer	Livestock killed, flooded property and evacuations Sewers burst	Upper Mersey CFMP
July 1973	Peak Forest Canal-	Breached banks	Damaged property and boats	Upper Mersey CFMP
July 2001	Audenshaw	Surface water	Flash flooding of homes and gardens	Tameside MBC
August 2002	Stalybridge	Surface water/drainage	Flooded roads and gardens	Tameside MBC

8.2.3. CFMP Assessment of Flood Risk

The District is covered by the draft Upper Mersey CFMP. Draft policies are subject to change and the SFRA must be adapted accordingly. The CFMP's have split the flood risk in the District into the three spatial areas or policy units, each assigned with a degree of risk (high, medium and low) as displayed in displayed in Table 8-5. The CFMPs also recommended a preferred policy option for each unit. The generic policy options are shown in Table 8-6.

Table 8-5: Policy units and preferred policy for Tameside MBC

Policy Unit	Policy Option	CFMP	Risk
PU3 Tame	5	Upper Mersey	Medium/High
PU7 Etherow	3	Upper Mersey	Low
PU8 Outliers	4	Upper Mersey	Low

Table 8-6 : Generic CFMP Policy

Policy 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)

8.2.4. Current and Future Flood Risk in Tameside MBC

Identification of Flood sources

Flooding from Rivers

The historic flood event search, the EA, the District Council, and the CFMP all suggest that one of the main flood risks within the District is flooding from rivers. Upper reaches of rivers in the catchment are susceptible to short-term intense rainfall events such as thunderstorm activity where large volumes of water are confined to relatively narrow river valleys. Areas surrounding confluences of tributaries and main channels such as the confluence of the Hollingworth Brook and River Etherow have an increased flood risk, particularly if flood peaks on both watercourses coincide or flow exceeds culvert capacity.

As Tameside is highly urban in places, many watercourses are culverted in sections and so flooding due to flow restrictions, which can be attributed to sedimentation and blockage of structures and weirs, is a risk and a known problem in the upper reaches of watercourses in Tameside. This type of flooding is primarily found upstream of structures when water backs up behind the blockage and ultimately overtops the channel.

Whilst fluvial flooding poses a significant risk to the District 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.

Flooding from the Land

During periods of prolonged rainfall events and sudden intense downpours, overland flow from adjacent 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. Pluvial flooding is a known issue in Hyde, Stalybridge and Dukinfield.

Flooding from Sewers

Sewer flooding is another identified flood risk throughout the District, 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 the watercourse. The water then backs up and will again start to discharge. Sewer flooding was identified using historical records from United Utilities DG5 database (June 2007) detailing the total number of flood events that affected both internal and external property.

It should be noted that much of the sewer network is thought to date 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 the WRC "Sewers for Adoption"[47] 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 this design standard is not achieved. It is therefore likely that much 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.

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) (Figure 8-2) 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 that is also covered by the Data Protection Act (1998). As a result, a detailed analysis of the scale and consequences of sewer flooding has not been possible at this stage of the SFRA.

[47] Sewers for Adoption, Wrc Publications 2006

However, during the course of this study, 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 and AGMA have agreed to share data on drainage and development areas initially for Bury and Salford. This will allow both UU and AGMA to determine the usefulness of the data and to agree how it can be spatially represented on a sub-regional and strategic basis for the whole of the AGMA area. It is anticipated that both UU and AGMA will have agreed the scale and format of the data in time for more detailed Level 2 SFRAs.

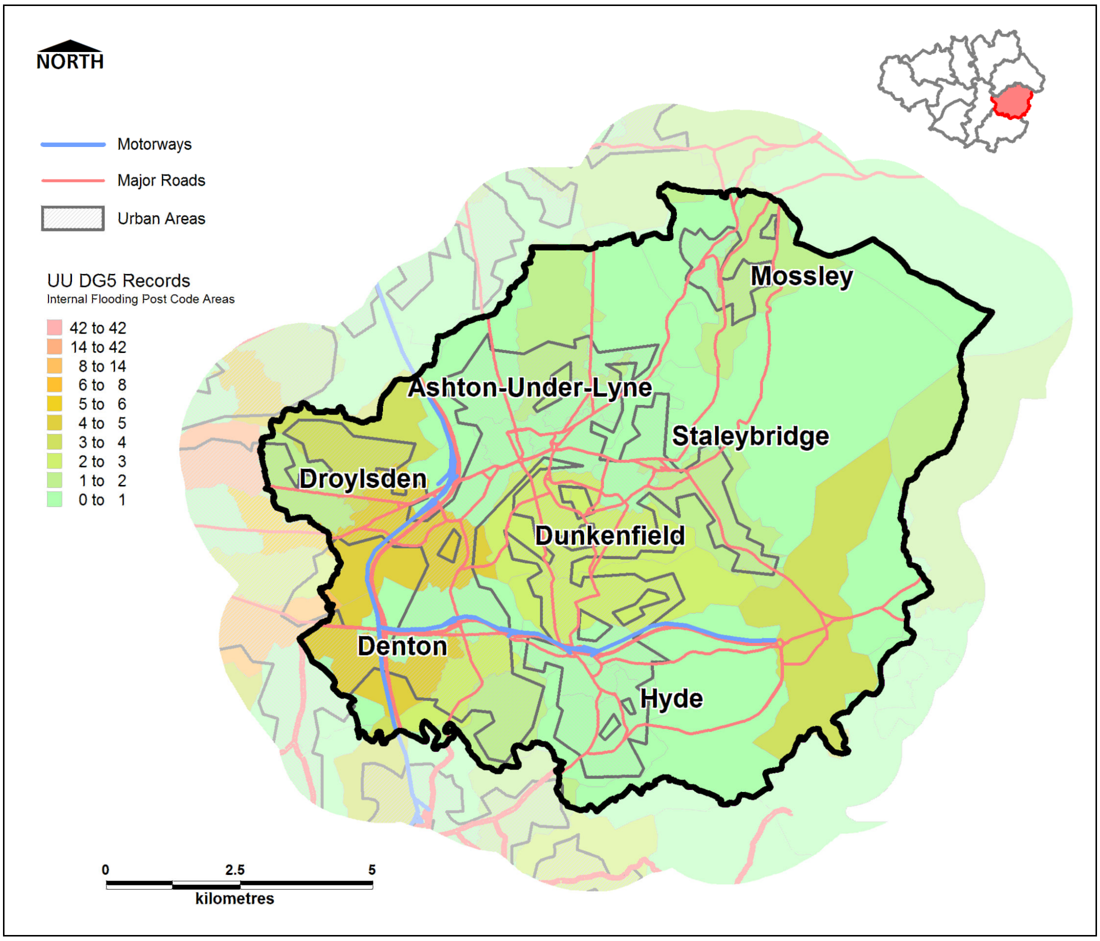


Figure 8-2: UU DG5 data (June 2007) showing instances of Internal Flooding by five-digit postcode area for Tameside MBC.

Flooding from Reservoirs, Canals and Artificial Sources

There are a number of reservoirs in and upstream of the District such as the Walkerwood and Swineshaw Reservoirs. Reservoirs have an attenuating effect on flood flows and can be used to control flows. Reservoirs do however have a flood risk associated with them in terms of dam/reservoir wall failure and emergency releases into the catchment. The likelihood of this occurring is minimal but impacts are potentially extremely high due to the limited warning time available and the potential high velocity and high volume flows.

The Huddersfield Narrow, Ashton, and Peak Forest canal run through the District. 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 remains where water levels could overtop or breach embanked sections. A preliminary study carried out by the EA has shown that there is an interaction in a 1 in 100 year event in between the River Tame and Huddersfield Narrow Canal in Mossley.

Flooding from Groundwater

Searches revealed no reported incidents of groundwater flooding in the District. However, work undertaken by DEFRA and the EA[48] has mapped groundwater emergence zones, and geological and groundwater vulnerability maps show the west of the District be underlain by permeable rocks, thereby there is the potential for groundwater emergence and flooding in the District.

British Geological Survey (BGS) Maps show the area to be underlain by more permeable rocks consisting primarily of mudstones, siltstones and sandstones. As a result, the EAs groundwater vulnerability maps show that much of central and eastern Tameside is classed as a Minor Aquifer (consisting primarily of the Sherwood Sandstone Aquifer).

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 have revealed no reported incidents of groundwater flooding in Tameside. However, work undertaken by the EA recently[49] has suggested that the cessation of mine dewatering and the slowing of abstraction from the aquifers, has led to an increase in groundwater levels, or groundwater rebound.

Searches revealed relatively few reported incidents of groundwater flooding in the District. According to the EAs water resources team and groundwater monitoring data, the risk posed by localised groundwater flooding is likely to remain remote. However, this could become more of an

[48] Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS 23) Final Report March 2004
[49] Groundwater Flood Risk and Management in the North West Region, Environment Agency, 2007.

issue in certain areas of the district due to the rising groundwater levels – especially those abutting rivers and canals, where local groundwater levels may be influenced by these sources.

The impacts of increased development in these areas must therefore 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.

Fluvial Flood Zones

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 and each outline used to create the SFRA flood zones assumes that no defences exist. There are no areas of tidal flood risk within the AGMA sub-region.

However, there are areas where little or no accurate flood outlines exist, and therefore, to ensure a continuous coverage across a flood zone, less accurate, broad-scale modelled (the EA J-FLOW Flood Zones) outlines were used instead. This hybrid approach provides a conservative flood zone and highlights potential uncertainties that can either be resolved in more detail at Level 2, or by developers as part of site-specific FRAs. The SFRA has identified the following flood zones in accordance with PPS 25

Flood Zone 1: Low Probability of Flooding
Land having a less than 1 in 1000 annual probability of river 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%) in any year.

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

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. Where possible, 1:20 or 1:25 year detailed modelled outlines were used to define the functional floodplain. Some defended areas may include flood storage basins which are by their very nature functional floodplain. 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 in the data and potential tasks for the more detailed Level 2 assessments. 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.

Using the Flood Zone maps, the total area of Tameside at risk of fluvial flooding can be determined. Table 8-7 and Figure A-5 (Appendix A) shows that significant areas of the district are at risk of fluvial flooding, with approximately 4% of the district area affected by Flood Zones 2 and 3. Of this flood risk, 3.5% is in urban areas.

Table 8-7: Area of Fluvial Flood Risk to Tameside MBC

District Area (ha)	Urban Area (ha)	Fluvial Flood Zone	Area (ha)	% (of District or Urban Area)
10,285.80	3,455.45	FZ3b	171.80	1.67
		FZ3a	64.44	0.63
		FZ3 in Urban	51.48	1.49
		FZ3 + CC	245.78	2.39
		FZ2	161.69	1.57
		FZ2 in Urban	65.88	1.91

Note: Figures for FZ3a refer to the area outside of FZ3b, figures for FZ3+CC and FZ2 refer to the area outside of FZ3a.

Flood Zone Confidence

Flood Zone Confidence Maps are intended to be used by planners as a tool for identifying areas of high, medium or low confidence in the data that has been used to derive fluvial Flood Zones across the sub-region and also to determine where further work is required. The confidence assigned to a Flood Zone demonstrates the level of detail and the number of assumptions made when deriving the Flood Zones. The maps can be used to determine reaches of river where further, more detailed work is required to refine Flood Zones and therefore where resources should be directed.

Table 8-8 illustrates the confidence assigned to the Flood Zones present within the Tameside MBC district. A map showing confidence in the each of the Flood Zones is presented at the end of this section (Figure Tameside Overview/03).

Table 8-8: Fluvial Flood Risk Confidence for Tameside MBC

District	Fluvial Flood Zone	Watercourse	Settlement	Source	Date of Modelling Study	Confidence
Tameside	3b	River Tame	Denton	EA Flood Zone Maps	NA (May 2008)	Low
			Mossley			
		River Tame	Mossley	Upper Mersey S105 Model	2001 (May 2008)	Low
			Stalybridge			
			Dukinfield			
			Ashton-under-Lyne			
		River Tame	Stalybridge	Tame NFCDD Tame 04	2008 (May 2008)	High
		River Tame	Uppermill	Tame NFCDD Tame 06	2008 (May 2008)	High
	3a	All Other Watercourses	NA	EA Flood Zone Maps	NA	Medium
		River Tame	Denton	Upper Mersey S105 Model	2001	High
			Dukinfield			
			Ashton-under-Lyne			
		River Tame	Stalybridge	Tame NFCDD: Tame 04	2008	High
		River Tame	Uppermill	Tame NFCDD: Tame 06	2008	High
	3a + CC	River Roch	Milnrow	Roch Tributary Model (DRAFT)	2006	Low
			Rochdale			
			Littleborough			
		River Spodden	Rochdale	Spodden Model	2004	Low
		River Tame	Stalybridge	Tame NFCDD: Tame 04	2008	High
		All Other Watercourses	Dukinfield	EA Flood Zone Maps - Flood Zone 2	NA	Low
			Denton			
			Hyde			
			Mossley			
		River Tame	Uppermill	Tame NFCDD: Tame 06	2008	High
	2	All	Mossley	EA Flood Zone Maps	NA	Medium
			Stalybridge			
			Ashton-under-Lyne			
			Dukinfield			

Climate Change and Future Flood Risk

The CFMP's have 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 District. 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. Stalybridge has been shown to be at particularly increased flood risk under sensitivity analysis.

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)[50] 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 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. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

The location of future urban developments and flood defences within a catchment can influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments. It may however be possible to mitigate against this 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.

To account for Climate Change at the sub-regional level, 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 the 100 year flood outline will necessarily increase to the 1000 year outline, but rather that one expects 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 Level 2 SFRA stage or during Site Specific FRAs (developer led).

Flood Risk Mitigation and Management

Flood defences may be hard formal structures designed for purpose such as flood walls, or they may be informal structures such as garden walls which were not designed as defence structures, but are now performing that role. NFCDD data along with CFMP's and council supplied data have identified the following major structures and flood defences assets in the District. It should be noted that the NFCDD is constantly being updated and amended and has a default value of a 50 Year Standard of Protection (SoP) for defences that are yet to be assessed or updated. Therefore the SoP values should be treated with caution and assessed (in conjunction with the EA) on a site-by-site basis during the more detailed Level 2 assessments.

NFCDD data along with CFMP's and council supplied data have identified flood defence structures and assets throughout the District, key ones being:

[50] 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

Defences: Numerous formal, informal and natural raised defences consisting of earthen bunds, walls and other raised features such as road and rail embankments.

Culverts and weirs: Numerous culverts and weirs on all watercourses- risk of collapse.

In addition to flood defence structures and assets, there are a number of reservoirs within Tameside including Audenshaw, Godley and Walkerwood Reservoirs. Whilst these have an attenuating affect on flood flows it must be noted that United Utilities do not operate the reservoirs for flood storage purposes.

By interrogating NFCDD outputs, a series of informative statistics about flood risk assets can be obtained. For Tameside MBC, data from NFCDD shows that there are over 31 km of culverted watercourses and 4.68 km of man made raised flood defences, 4.11 km of which have a SoP of between 21 and 50 years (Table 8-9). The SoP offered by flood defences varies along the length of a watercourse and also throughout the catchment. Defences designed to a certain SoP may, over time, decrease in standard due to normal deterioration in asset condition and the impacts of climate change such as increased flows.

Table 8-9: NFCDD data summarising lengths of flood defence asset in the Tameside MBC Area (km) by Standard of Protection (return period in years).

Asset Type	Length of FRM Asset (km) by Standard of Protection in years					
	Unclassified	0-20	21-50	51-75	76-100	Total
Culverted Channel	10.32	13.95	6.72	0.08	0.00	**31.07**
Maintained Channel	0.00	0.17	0.04	0.00	0.00	**0.21**
Natural Channel	0.00	0.40	29.32	0.98	0.00	**30.71**
Flood Defence Structure	0.00	0.04	51.74	2.72	0.61	**55.12**
Non-Flood Defence Structure	0.00	0.23	0.58	0.04	0.00	**0.85**
Raised Defence (Man-Made)	0.00	0.08	4.11	0.49	0.00	**4.68**
Total	**10.32**	**14.87**	**92.52**	**4.32**	**0.61**	**122.64**

Mitigation Measures

There are many different types of flood risk mitigation actions ranging from small, single dwelling flood proofing measures to flood warning services to large multi-million pound flood defence schemes.

There are flood warning areas (FWAs) on the River Etherow at Woolley Bridge. However, flood warnings tend to work most effectively during large events with long lead times so that sufficient advance notice is given to residents and businesses and are usually only applicable to fluvial flooding. In the case of intense, flashy rainfall events, where pluvial and sewer flooding may pose the most risk, flood warnings schemes rarely exist.

Risk of Failure of Defences and Impacts

Behind defended areas there is a residual risk of 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 tend to be low lying, and the water level will have often built up to a higher level than ground levels of the defended area. The same risks can be associated with reservoir/dam failure, though the risk of such failures is considered to be minimal. Throughout Tameside, there are extensive flood defences of varying SoP and condition that provide a level of protection. However, compared to other councils in the AGMA sub-region (for example, Salford), the impacts of defence failure are less severe.

People and Property at risk of flooding

The EA carried out a strategic review of flood risk for the whole of the North West Region[51]. This looked at the EA Flood Zones and the number of properties at risk of flooding within each District in the North West. Table 8-10 shows the number of properties at risk of flooding in each flood zone.

Table 8-10: Properties at risk of flooding (source: EA Flood Zone Ranking using EA Flood Zones)

FZ3	FZ2&3	FZ1	Total
631	1,075	100,299	101,374

Using census Output Area (OA) data (the smallest census geographical area), and updated mid-term 2005 population estimates for Tameside, the potential populations affected by flooding in the different flood zones are presented in Table 8-11. 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 a district, 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 a OA by the type of accommodation they live in. Again, assuming an even distribution across a OA, an indication as to the predominant types of properties at risk can be shown.

Table 8-11: Approximate number of people affected by fluvial flooding in Tameside

	Population at Risk (2005)	People living in House Bungalow	People living in Flat or Apartment	People living in Caravans or moveable Accommodation	People living in Shared Dwelling
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

[51] 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)

From these coarse statistics, it can be seen that the majority of people potentially affected by fluvial flooding in Tameside reside in houses or bungalows in Flood Zone 3 and Flood Zone 2. There is a large proportion of people shown to be affected in FZ3b due to the fact that for many areas of the District, functional floodplain has not been defined through detailed modelling. As a result, the modelled outlines for FZ3a were used as a proxy.

8.3. Strategic Overview of Flood Risk for Tameside MBC

8.3.1. Consequences of Upstream and Downstream Development

Broad development upstream of Tameside within the Upper Mersey catchment is defined within the RSS in terms of housing figures. The districts upstream that are connected to Salford hydrologically therefore have the potential to adversely affect the current flood risk in Tameside. As the district is located towards the upstream extent of the Upper Mersey catchment, there is potential for development from two districts, both within and adjacent to, the AGMA sub-region to affect flood risk in Tameside (Figure 8-3). 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.

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.

Should RSS housing targets be met, for example, a total of 10,700 new homes will be built in districts upstream of Tameside. Within the AGMA sub-region, a further 110,300 homes are proposed in districts downstream of Tameside. These figures are for net new housing and so are additional to the current levels of development. Furthermore, all of the districts within the AGMA sub-region have a high target for development on previously developed land (PDL). As a result, if no measures are taken to control runoff there is a potential for some of the new development to cause an increase in flood risk to Tameside as it is likely that much of the new development will be constructed to modern and sustainable standards incorporating, where possible, SuDS to limit runoff. Tameside has a large housing target (13,500) under the RSS within the sub-region. Development is likely to be more dispersed across Tameside compared to other District's. Development is likely to continue at Hattersley, Ashton Moss and the M67 gateway and is also likely to be concentrated around existing town centres.

Downstream and adjacent to Tameside are Stockport MBC, Manchester CC, Trafford MBC and Salford CC. Development and expansion aspirations within Tameside, as identified above in Section 8.1.2, are large and ambitious. Development in Tameside has the potential to impact on the flood risk of downstream and adjacent districts. In reality, however, it is likely that new development will be constructed to modern and sustainable standards following current best practise guidelines and policy (PPS25) and incorporating, where possible, SuDS to limit runoff.

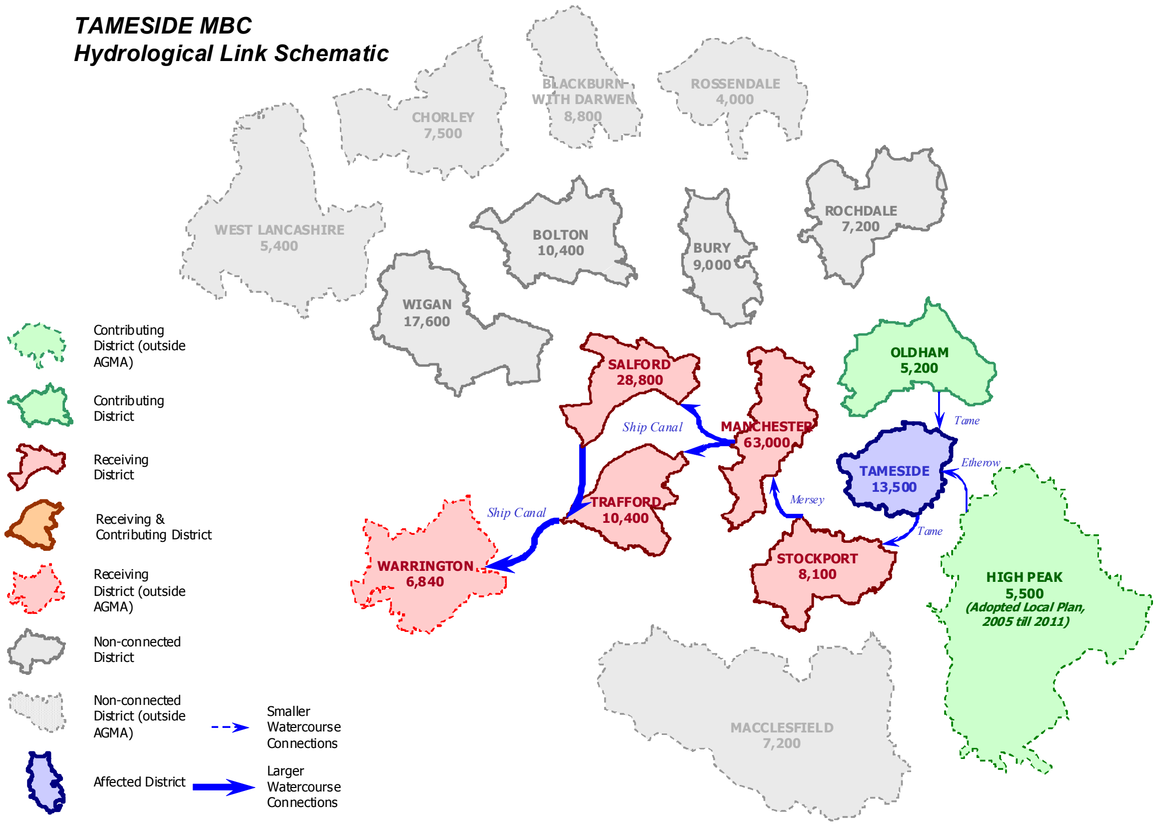


Figure 8-3: Hydrological links for Tameside

8.3.2. Potential Conflicts between broad development aspirations and the PPS25 Sequential Test

As highlighted above, the current flood risk to the district is primarily from fluvial sources, in particular the River Tame and Etherow. Whilst on a smaller and more localised scale, significant and more frequent flooding problems have also been identified as a result of sewer and drainage issues. In addition, there is at present an unquantified risk of flooding from the canals that run through the District, including the Huddersfield Narrow, Ashton, Peak Forest and Manchester and Ashton-Under-Lyne Canals.

As discussed in Section 8.3.1, development is likely to be dispersed across the District with concentrations around existing urban centres, Ashton-Under-Lyne, Mossley, Hattersley and the

M67 gateway. Where sites are located near to rivers and canals, there is an inherent potential flood risk from these sources and therefore a potential conflict with the PPS25 sequential test.

The RSS has identified a target of 80% of new development previously developed land, with the remainder on greenfield areas of the district. Nevertheless, there is potential for an increase in the amount of impermeable area and the subsequent increases in runoff and the impacts on surface water and sewer flooding. Using UU data and the Urban Morphology Types (UMT) boundaries from the ASSCUE project the percentage of impermeable areas within the district can be identified and it is recommended that the risks associated with potential surface water (pluvial) and sewer flooding in these areas is examined in more detail at the Level 2 stage.

Potential conflicts exist between development and the PPS25 Sequential Test within the District. In order to examine these in more detail, it will be necessary to create maps showing more detailed flood outlines taking into account functional floodplain and climate change (as per PPS25 requirements) and displaying the risk associated with the canal network during Level 2 assessments.

8.3.3. Impacts on and from other strategic spatial considerations

Other spatial considerations that Tameside MBC should take account of with regards to flood risk include the Greater Manchester Green Infrastructure Scoping Study 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. However, it is nonetheless 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.

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.

Waste and hazardous substances can also be affected by flooding and potentially introduce harmful and polluting substances into flood waters for transport and distribution elsewhere. The Greater Manchester Waste DPD is currently being undertaken and identifies current and future areas for waste management, storage and transfer. Using this in conjunction with the SFRA may help to reduce the risk of flooding to waste sites.

8.3.4. Strategic Effects of Defence failure

As highlighted above, the main water courses within Tameside have extensive raised flood defences. In particular, there are relatively small areas through Ashton-under-Lyne and Denton where a residual risk of defence failure exists. The impacts include fast flowing, deep water through the defended areas.

8.3.5. Identifiable strategic mitigation options

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. Similarly, locating storage facilities too low in the catchment may also have limited benefits and be difficult to locate due to the lack of suitable locations (in terms of topography, urban extent and available land). 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.

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, and 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 within Tameside and Stockport and 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 not all are based in Tameside, they provide benefits to all districts downstream.To meet the costs of catchment and AGMA wide flood risk management options, it may be necessary for the council to consider a local tariff-based system into the local development plan process. This would allow funds to be raised from new developments that fall into potential flood risk areas. The system could also be run in conjunction with other AGMA councils on the sub-regional basis to fund large flood risk mitigation/management schemes across the Greater Manchester area.

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

Tameside_Overview/01

Tameside_Overview/02

Tameside_Overview/03

9. Trafford Metropolitan Borough Council

9.1. Trafford Development and Planning Context

Trafford Metropolitan Borough is situated in the south of the conurbation and southwest of the regional centre. The Manchester Ship Canal forms its northern boundary with Salford City Council and Manchester International Airport lies to the southeast. The District is one of the smaller councils within the conurbation covering an area of 10,600 hectares and has a population of 210,000 (UDP, 2006).

Trafford MBC has good access to the main road and rail network of the conurbation, the region and beyond, lying astride the M60, the A56 and the Altrincham-Manchester-Bury Metrolink, with ready access to the M56 motorway, the Manchester-Liverpool and Manchester-Chester rail lines. The District comprises some of the regions key centres for industry and business such as Trafford Park, Carrington and The Trafford Centre and is a longstanding destination for leisure and tourism having seen development of some of the regions important facilities such as Dunham Park and Hall, the Imperial War Museum North, and the District is also home to two sporting facilities of internationally renown.

The Annual Monitoring Report (AMR) describes the District as prosperous but with areas of significant contrast – with inner urban areas of relatively low prosperity and poor quality environment, resident suburbs of greater prosperity and good environment, an isolated urban settlement at Partington and high quality attractive open countryside. A map presenting planning information for Trafford is included at the end of this section (Figure Trafford Overview/02).

9.1.1. Strategic and Regional Position

Wharfside on the northern edge of the District forms part of the Regional Centre as outlined in Policy MCR2 of the Regional Spatial Strategy (RSS). The Regional Centre is the primary economic driver for the region providing the main focus for leisure, culture and tourism development and seeks to encourage residential development where:-

- It is part of a mix used employment scheme comprising a good range of sizes, type and tenure.
- Contributes towards the vitality and viability of the regional centre
- Will not be of a scale detrimental to other housing developments including HMR initiatives within the sub region.

The policy supports an increase in population, major regeneration activity and the creation of sustainable communities and provides that Plans and Strategies for the area should seek to encourage employment opportunities that accord with Policy W3 of the RSS. Consideration is given to the scope for mixed-use development and office development should as far as possible, be focused within the Regional Centre in accordance with Regional Spatial Framework.

The Inner Area, surrounding the Regional Centre, which comprises the Trafford Park industrial area, is important for the economic growth and expansion of the Regional Centre and suitable for local economic development. Development, particularly economic activity within these areas will help to reduce local inequalities and deprivation.

9.1.2. Unitary Development Plan

The Planning and Compulsory Purchase Act makes provision for existing statutory development plan status to be "saved" for a period of 3 years from the commencement of the Act or 3 years from the date of the plan adoption in the case of the plan. Plan policies, however, may be saved beyond this 3 year period with the agreement of the Secretary of State provided certain conditions exist. The Council intends to seek to "Save" all of the Policies and Proposals of the Adopted Revised Trafford UDP until they can be replaced by the new LDF documents.

In summary, the UDP policies and proposal are intended to respond to development pressures and opportunities within the District. At its heart is the aim to deliver sustainable development. The plan is also informed by regional guidance, as it existed prior to the Draft Regional Spatial Strategy, sub-regional planning framework but also the Local Strategic Partnership objectives for the economic, social and environmental well-being and the Council's own key priority policy areas. To this end the Plan establishes broad overarching themes to guide development proposals, these are set out in Part 1 Policy GP1 – The Themes of the Plan.

Furthermore, in spatial terms, the Plan introduces Area Based Policies to provide the broad context within which the detailed Policies and proposals can be set. These are grouped into 3 Categories – Priority Regeneration Areas, Areas for Improvement and Areas for Protection. These areas are central to recognising those locations where the future growth of the District will occur and for identifying the main drivers to spatial policy.

9.1.3. Local Development Framework

Timetable

The Local Development Framework (Revision A) outlines the MBC's priority DPDs for production within the next 3 years. The Council adopted several LDF documents during 2006/7, these include Statement of Community Involvement, A56 Corridor Development Guide and Developer Contributions to Highways and Public Transportation Schemes SPDs. The Council also intends to carry forward the production of 4 DPDs including the Core Strategy and the Site Allocations DPD, the Partington Area Action Plan and the Joint Waste DPD, which, with the exception of Wigan MBC will involve the remaining Greater Manchester Authorities. The GM Waste DPD will be at the 2nd Stage Issues and Options Paper in January 2008. The Council also intends to produce 3 Supplementary Planning Documents, to guide house extensions, to set out vehicle parking standards, and a further SPD on affordable housing guidelines.

Regarding the preparation of the Core Strategy, the MBC has published and consulted on the Issues and Options, of which the following Options are identified as being the Council's priorities:-

Option 1 – Focus growth in and adjacent to the Regional Centre and in the remaining Regeneration Areas with restraint elsewhere.

Option 2 – Focus Growth initially across the whole of the north of the District, and secondly within the remaining Regeneration Areas, with restraint elsewhere.

Options 3 – Focus growth in the north of the District with restraint in the south of the District

Consultation on the Preferred Option is expected to take place in November/December 2007, and the anticipated adoption of the Core Strategy in December 2009.

Housing Land

Trafford has a strong and buoyant housing market and a healthy demand for housing across all tenures. Since the start of the RSS plan period development has proceeded at a rate in excess of the RSS requirement (Figure 9-1).

Whilst the Draft RSS proposes a revised level of housing development for the District over the period 2003 to 2021 of 7,740 new dwellings net of clearance replacement – an average of 430 new dwellings per year the published Panel report recommends an increase in the level of new housing development net of clearance of 10,400 dwellings – an average of 578 per year. However, since April 2001 development across the District has taken place at an average rate of 619 dwellings per year, exceeding the rate proposed in the Draft RSS and above the rate proposed by the RSS Panel.

There is significant focus on the development of flats and apartment units and this has continued particularly in the north of the District. The proportion of units built at a density in excess of 50 per hectare has grown to a ratio of 3:1. Whilst, an increase in the proportion of development on previously developed land is desirable, development on historic green-field commitment sites have come forward to meet demand. However, the proportion of build within Priority Regeneration Areas has increased, this relates to development within areas such as Gorse Hill, Old Trafford and Partington.

The building of apartment developments across the District has increased the amount of high density (in excess of 50 per hectare) development (AMR 2006/7).

Table 9-1: Housing targets

	Target
Overall Housing Increase 2003-21	10,400
Mean Annual Increase	578
Indicative Previously Developed Land	80%

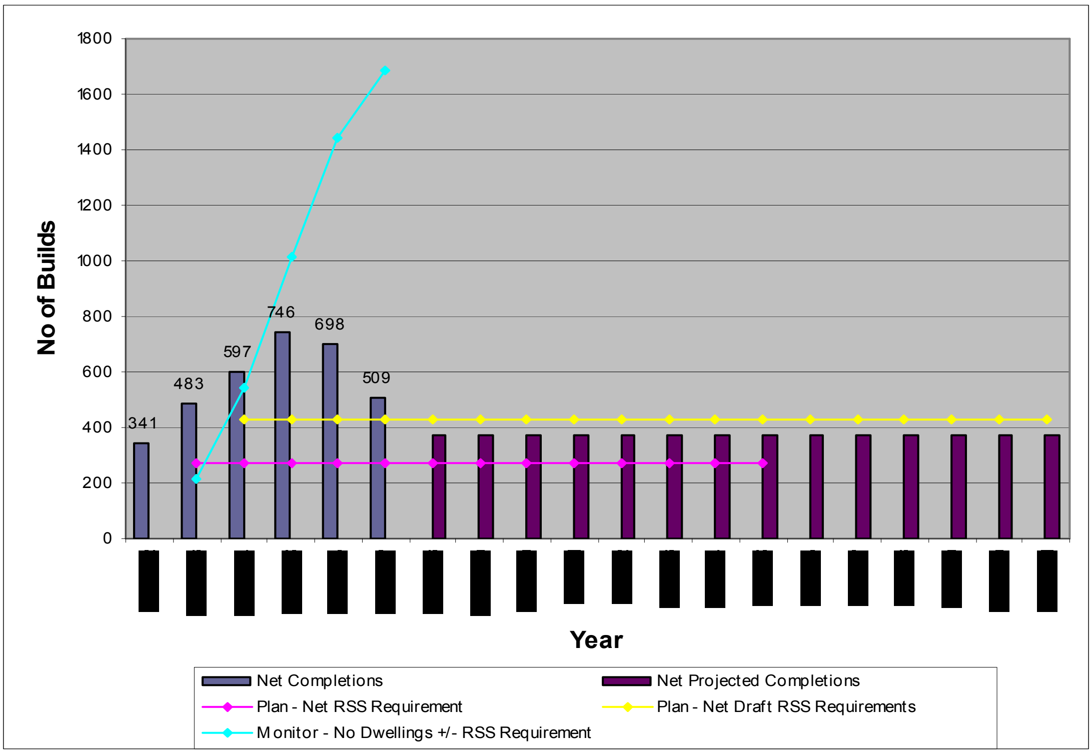


Figure 9-1: Housing Trajectory for Trafford Council

Employment Land

Trafford has approximately 150 hectares of employment land supply, but this is likely to increase particularly on Trafford Park. The current employment land supply is taken from the Council's own employment land database. The Council is currently undertaking its employment land review.

Table 9-2 Employment Land

Allocated	62.06
Available	2.66
Full Planning Permission	26.15
Outline Planning Permission	46.22
Resolution to Approve	8.08
Total	**145.17 ha**
Pipeline Supply	72.37

In summary, the District comprises of the long established centres of industry and commerce of regional importance such as Trafford Park and Carrington which the Council wishes to see transformed by defining sites more specifically and to increase densities. The Ship Canal Corridor (Pomona to Carrington) will accommodate the hub of the creative and digital media uses that will co-exist alongside the BBC departments and Granada. The area will include a mix of other leisure, commercial and residential and uses to revitalise the waterfront location. Carrington Employment Zone, whilst the area has underperformed as an employment zone the Council recognises the need for public interventions and are exploring a range of potential options including the creation of a new zero carbon development that promotes sustainable forms of urban living. The commercial centres of Altrincham, Sale, Stretford and Urmston are existing hubs for commercial activity and residential development. In addition to its traditional town centre retail areas, a major out-of-centre retail provision has been built at the Trafford Centre (a regional shopping facility on the western edge of Trafford Park). The Council aims to encourage continued development along the A56 Corridor to provide a range of commercial/leisure activities. Its location near to Manchester International Airport provides Davenport Green a unique advantage to attract international business and commerce to the District.

Infrastructure

Trafford is well-served by public transport and in terms of strategic road corridors. The M60 provides a key east-west strategic road corridor through the District whilst also linking it to the motorway network, and the A56 provides a vital north-south strategic road corridor, and provides connection to the Regional Centre. The Authority has aspirations to introduce an extension to the existing Metrolink network into the proposed Media City, ahead of the redevelopment of the Quays for the BBC relocation.

9.2. Trafford Flood Risk Summary

9.2.1. Hydrological background: catchment and watercourse network

Trafford MBC lies within the Greater Manchester SFRA area. The District is situated in the middle and lower reaches of the Rivers Mersey and Sinderland Brook. Other watercourses within the District include the Manchester Ship and Bridgewater Canals, Timperley Brook and Fairywell Brook along with numerous smaller watercourses. All of these watercourses carry with them an inherent potential flood risk. The middle and lower reaches of catchments have flatter and lower topography than the upper catchment areas, and flooding can be spread over a larger area than in the steeper and more confined floodplains of the upper catchment.

The main urban areas at greatest risk from flooding in the District are Sale, Flixton, Stretford, Altrincham and Urmston. The draft Upper Mersey CFMP and the River Irwell CFMP provide a catchment wide assessment of flood risk and are used by the EA to inform flood risk management strategy within a catchment. Both CFMPs also provide flood risk information of particular relevance to Trafford that can be used to increase the quality and accuracy of flood risk information presented in the SFRA. Table 9-3 shows the main watercourses and urban areas at risk of flooding from each. A map presenting flood risk information for Trafford is included at the end of this section (Figure Trafford Overview/01).

Table 9-3: Watercourse and Urban Area at Risk in Trafford MBC

Main Watercourses	Urban area at risk
Bollin	Hale
Mersey	Sale, Stretford, Urmston, Flixton
Sinderland/Timperley Brook	Hale, Altrincham, Brooklands Broadheath, Sale
Baguley Brook	Sale

9.2.2. Historical Flooding

A review of the information supplied by the council, the EA, CFMP's, and through searching online historical records[52], has revealed that Trafford has experienced a number of flood events throughout the last century. Historically the District has experienced river flooding predominantly from the Mersey and surface water and sewer flooding from localised intense rainfall events. The historic records of flooding show that the District is vulnerable to both periods of prolonged rainfall in the autumn and winter months mainly leading to fluvial flooding, and local flash flooding primarily of surface and sewer water caused by intense summer downpours. Table 9-4 shows a number of significant historical flood events.

[52] British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe

Table 9-4: Significant Historic Flood Events

Date	Location	Source of flooding	Impact	Source of information
November 1923	River Mersey, Sale	Fluvial	Flooding up to 11ft deep in Sale Priory.	BHS Database
December 1965	River Mersey, District wide	Torrential rainfall	Livestock killed, flooded property and evacuations Sewers burst	Upper Mersey CFMP
September 2000	River Mersey, Sale	Intense rainfall	Flash flooding of doctors surgery	Online search of local newspaper
August 2004	Altrincham	Sewer flooding following intense rainfall	Internal and external property flooding	Trafford MBC
July 2004	Flixton	Sewer flooding following intense rainfall	Flooded highway	Trafford MBC
July 2004	Hale	Sewer flooding following intense rainfall	Flooded highway and cellars	Trafford MBC
July 2004	Sale	Blocked culvert	Flooded gardens	Trafford MBC

9.2.3. CFMP Assessment of Flood Risk

The District is covered by the draft Upper Mersey and the River Irwell CFMP. Draft policies are subject to change and the SFRA must be adapted accordingly. The CFMPs have split the flood risk in the District into 5 spatial areas or policy units, each assigned with a degree of risk (high, medium and low) as displayed in Table 9-5. The CFMPs also recommended a preferred policy option for each unit. The generic policy options are shown in Table 9-6.

Table 9-5: Policy units and preferred policy for Trafford MBC

Policy Unit	Policy Option	CFMP	Risk
PU2 Bollin	3	Draft Upper Mersey	Low/Medium
PU4 Mersey	5	Draft Upper Mersey	High
PU5 Upper Sinderland	4	Draft Upper Mersey	High
PU8 Outliers	4	Draft Upper Mersey	Low
1: Manchester to Irlam (MSC)	4	River Irwell	Low

Table 9-6: Generic CFMP Policy

Policy 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)

9.2.4. Current and Future Flood Risk in Trafford MBC

Identification of Flood sources

Flooding from Rivers

The historic flood event search, the EA, the City Council, and the CFMP all suggest that the main flood risk within the District is flooding from rivers. The main fluvial flood risk areas in Trafford are the River Mersey at Flixton, Sale, and Altrincham. Up to 5,443 properties are at risk of river flooding on the Sinderland/Timperley Brook, the majority of which are in Sale and Altrincham. Lower reaches of rivers in the catchment tend to be at risk from fluvial flooding. Areas surrounding confluences of tributaries and main channels, such as the confluence of the Old Eea Brook and the Mersey in Urmston or Baguley and Fairywell Brook to the west of Brooklands, have an increased flood risk, particularly if flood peaks on both watercourses coincide or flow exceeds culvert capacity.

As Trafford is highly urban in places, many watercourses are culverted in sections and so flooding due to flow restrictions, which can be attributed to sedimentation and blockage of structures and weirs, is a risk throughout the District. This type of flooding is primarily found upstream of structures when water backs up behind the blockage and ultimately overtops the channel.

Whilst fluvial flooding poses a significant to the District, 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.

Flooding from the Land

During periods of prolonged rainfall events and sudden intense downpours, overland flow from adjacent 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. Pluvial flooding has occurred in Altrincham and Sale.

Flooding from Sewers

Sewer flooding is another identified flood risk throughout the District, particularly during severe rainfall events, where the design capacity of the sewer network is insufficient to cope with the high volumes of water. Sewer flooding is a known issue in Altrincham, Flixton and Sale. During periods of high river flow, there is the potential for such drainage systems to become 'tide locked' and unable to discharge to the watercourse. The water then backs up and will again start to discharge. Sewer flooding was identified using historical records from United Utilities DG5 database (June 2007) detailing the total number of flood events that affected both internal and external property.

It should be noted that much of the sewer network is thought to date 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 the WRC "Sewers for Adoption"[53] 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 this design standard is not achieved. It is therefore likely that much 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.

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) (Figure 9-1) 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 that is also covered by the Data Protection Act (1998). As a result, a detailed analysis of the scale and consequences of sewer flooding has not been possible at this stage of the SFRA.

However, during the course of this study, 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

[53] Sewers for Adoption, Wrc Publications 2006

data. UU and AGMA have agreed to share data on drainage and development areas initially for Bury and Salford. This will allow both UU and AGMA to determine the usefulness of the data and to agree how it can be spatially represented on a sub-regional and strategic basis for the whole of the AGMA area. It is anticipated that both UU and AGMA will have agreed the scale and format of the data in time for more detailed Level 2 assessments.

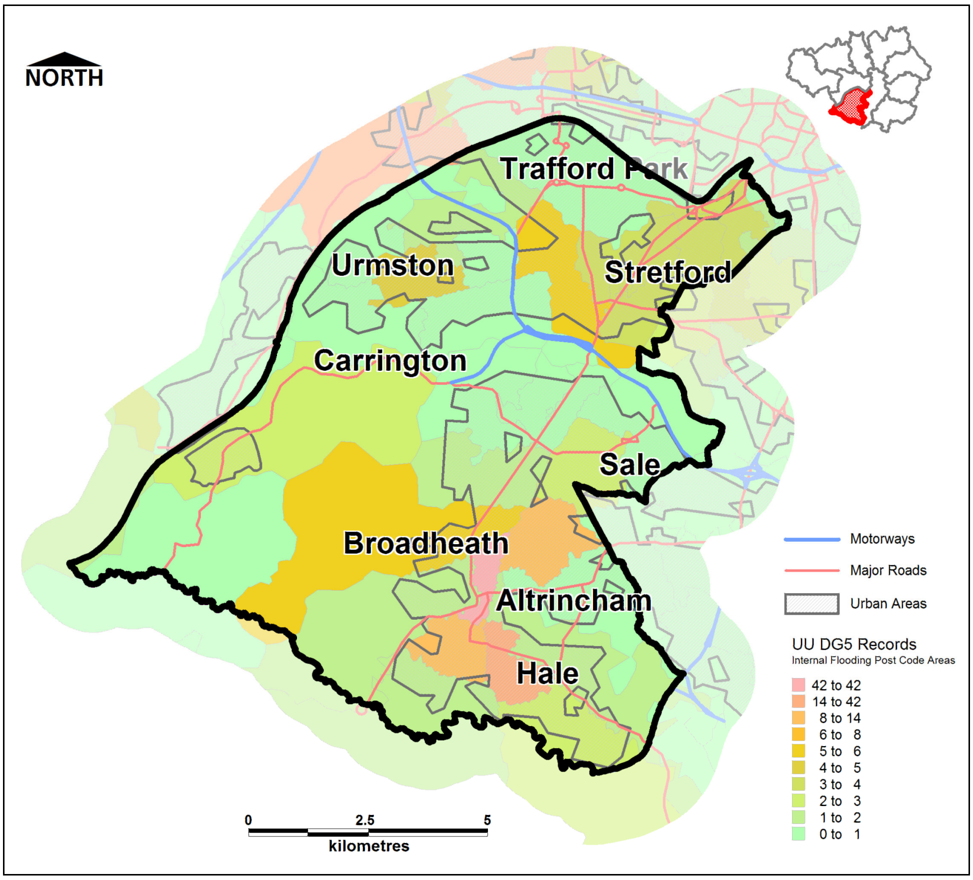


Figure 9-1: UU DG5 data (June 2007) showing instances of Internal Flooding in Trafford MBC by five-digit postcode area.

Flooding from Reservoirs, Canals and Artificial Sources

The Bridgewater and Manchester Ship Canal run through the District. 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 remains where water levels could overtop or breach embanked sections. 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.

In depth discussions have been held with MSCC to determine what, if any, flood risk information and knowledge is available for strategic planning purposes in the SFRA. MSCC commissioned a detailed modelling exercise of the canal[54] to determine how the canal will react during a flood event and to enable the most efficient operational response. This exercise is nearing completion though the full results are not expected until the end of the autumn of 2007. Once the study is complete, MSCC intend to provide the information to the EA to review and determine the flood risk issues. 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. This is expected to happen during Level 2 of the SFRA.

Flooding from Groundwater

British Geological Survey (BGS) Maps show the area to be underlain by more permeable rocks consisting primarily of mudstones, siltstones and sandstones. As a result, the EAs groundwater vulnerability maps show that much of the northern and eastern areas (following the Mersey and MSC corridor) of the City Council is classed as a Major Aquifer (consisting primarily of the Sherwood Sandstone Aquifer).

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 District. However, work undertaken by DEFRA and the EA has shown that flooding from groundwater is shown to become a potential issue in Trafford 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 EAs water resources team and groundwater monitoring data, the risk posed by localised groundwater flooding is likely to remain remote. However, this could become more of an issue in certain areas of the district due to the rising groundwater levels and the major aquifer – especially those abutting the MSC and River Irwell., where local groundwater levels may be influenced by the river and canal.

The impacts of increased development in these areas must therefore 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.

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

Fluvial Flood Zones

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 and each outline used to create the SFRA flood zones assumes that no defences exist. There are no areas of tidal flood risk within the AGMA sub-region.

However, there are areas where little or no accurate flood outlines exist, and therefore, to ensure a continuous coverage across a flood zone, less accurate, broad-scale modelled (the EA J-FLOW Flood Zones) outlines were used instead. This hybrid approach provides a conservative flood zone and highlights potential uncertainties that can either be resolved in more detail at Level 2, or by developers as part of site-specific FRAs. The SFRA has identified the following flood zones in accordance with PPS 25

Flood Zone 1: Low Probability of Flooding
Land having a less than 1 in 1000 annual probability of river 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%) in any year.

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

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. Where possible, 1:20 or 1:25 year detailed modelled outlines were used to define the functional floodplain. Some defended areas may include flood storage basins which are by their very nature functional floodplain. As agreed with AGMA and the EA, if detailed modelled outlines did not exist, then the SFRA Flood Zone 3a 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 in the data and potential tasks for the more detailed Level 2 assessments. 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.

Using the Flood Zone maps, the total area of Trafford at risk of fluvial flooding can be determined. Table 9-7 and Figure A-5 (Appendix A) show that the main areas at risk of fluvial flooding in the District follow the Mersey corridor with approximately 12% of the district area affected by Flood Zones 2 and 3. Of this flood risk, a relatively small 3.5% is in urban areas.

Table 9-7: Area of Fluvial Flood Risk to Trafford MBC

District Area (ha)	Urban Area (ha)	Fluvial Flood Zone	Area (ha)	% (of District or Urban Area)
10,569.60	4,836.25	FZ3b	857.57	8.11
		FZ3a	63.29	0.60
		FZ3 in Urban	75.14	1.55
		FZ3 + CC	367.79	3.48
		FZ2	367.79	3.48
		FZ2 in Urban	104.40	2.18

Note: Figures for FZ3a refer to the area outside of FZ3b, figures for FZ3+CC and FZ2 refer to the area outside of FZ3a.

Flood Zone Confidence

Flood Zone Confidence Maps are intended to be used by planners as a tool for identifying areas of high, medium or low confidence in the data that has been used to derive fluvial Flood Zones across the sub-region and also to determine where further work is required. The confidence assigned to a Flood Zone demonstrates the level of detail and the number of assumptions made when deriving the Flood Zones. The maps can be used to determine reaches of river where further, more detailed work is required to refine Flood Zones and therefore where resources should be directed.

Table 9-8 illustrates the confidence assigned to the Flood Zones present within the Trafford MBC district. A map showing confidence in the each of the Flood Zones is presented at the end of this section (Figure Trafford Overview/03).

Table 9-8: Fluvial Flood Risk Confidence for Trafford MBC

District	Fluvial Flood Zone	Watercourse	Settlement	Source	Date of Modelling Study	Confidence
Trafford	3b	Chorlton Brook	NA	Chorlton SFRM CPG	2008 (May 2008)	High
		All Other Watercourses	Stretford	EA Flood Zone Maps	NA (May 2008)	Low
			Urmston			
		River Mersey, Sinderland Brook, Timperley Brook	Altrincham	Upper Mersey S105 Model	2001 (May 2008)	Low
			Sale			
	3a	River Mersey, Sinderland Brook, Timperley Brook	Altrincham	Upper Mersey S105 Model	2001	High
			Sale			
		All Other Watercourses	Stretford	EA Flood Zone Maps	NA	Medium
			Urmston			
		Chorlton Brook	NA	Chorlton SFRM: CPG	2008	High
	3a + CC	All Other Watercourses	Sale	EA Flood Zone Maps - Flood Zone 2	NA	Low
			Altrincham			
			Stretford			
			Urmston			
		Chorlton Brook	NA	Chorlton SFRM: CPG	2008	High
	2	All Other Watercourses	Altrincham	EA Flood Zone Maps	NA	Medium
			Sale			
			Stretford			
			Urmston			
		Chorlton Brook	NA	Chorlton SFRM: CPG	2008	High

Climate Change and Future Flood Risk

The CFMP's have 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 District. 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. Sensitivity testing during the draft Mersey CFMP has shown that Sale is most vulnerable to increased flood risk under the sensitivity analysis.

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)[55] programme examined surface water runoff during extreme rainfall events in the Manchester sub-

[55] 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

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 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. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

The location of future urban developments and flood defences within a catchment can influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments. It may however be possible to mitigate against this 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.

To account for Climate Change at the sub-regional level, 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 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 Level 2 assessments or during Site Specific FRAs (developer led).

Flood Risk Mitigation and Management

Flood defences may be hard formal structures designed for purpose such as flood walls, or they may be informal structures such as garden walls which were not designed as defence structures, but are now performing that role. NFCDD data along with CFMP's and council supplied data have identified the following major structures and flood defences assets in the District. It should be noted that the NFCDD is constantly being updated and amended and has a default value of a 50 Year Standard of Protection (SoP) for defences that are yet to be assessed or updated. Therefore the SoP values should be treated with caution and assessed (in conjunction with the EA) on a site-by-site basis during the more detailed Level 2 assessments.

NFCDD data along with CFMP's and council supplied data have identified flood defence structures and assets throughout the District, key ones being:

Defences: Numerous formal, informal and natural raised defences consisting of earthen bunds, walls and other raised features such as road and rail embankments.

Culverts and weirs: Numerous culverts and weirs on all watercourses- risk of collapse and blockage.

Flood Storage: Timperley Flood Storage Area, Timperley Brook, Altrincham (EA)
Sale Water Park, River Mersey

By interrogating NFCDD outputs, a series of informative statistics about flood risk assets can be obtained. For Trafford Council, data from NFCDD shows that there are over 13km of culverted watercourses and 22.7km of man made raised flood defences, 10km of which have a SoP of between 21 and 50 years (Table 9-9). The SoP offered by flood defences varies along the length of a watercourse and also throughout the catchment. Defences designed to a certain SoP may, over time, decrease in standard due to normal deterioration in asset condition and the impacts of climate change such as increased flows.

Table 9-9: NFCDD data summarising lengths of flood defence asset in the Trafford MBC Area (km) by Standard of Protection (return period in years).

Asset Type	Length of FRM Asset (km) by Standard of Protection in years					
	Unclassified	0-20	21-50	51-75	76-100	Total
Culverted Channel	2.43	4.09	8.65	0.11	0.24	**13.09**
Maintained Channel	0.00	0.21	0.18	0.00	0.01	**0.40**
Natural Channel	0.00	22.22	30.67	1.98	4.57	**59.43**
Flood Defence Structure	0.00	10.28	39.67	6.63	1.29	**57.87**
Non-Flood Defence Structure	0.00	0.21	0.34	0.00	0.01	**0.56**
Raised Defence (Man-Made)	0.00	11.21	10.10	0.00	1.35	**22.66**
Total	**2.43**	**48.22**	**89.61**	**8.72**	**7.46**	**154.01**

Mitigation Measures

There are many different types of flood risk mitigation actions ranging from small, single dwelling flood proofing measures to flood warning services to large multi-million pound flood defence schemes.

Trafford MBC has been served well by the flood warning service provided by the EA for many years. The main Flood Warning Areas (FWAs) in Trafford exist in through Sale, Carrington and Urmston. However, flood warnings tend to work most effectively during large events with long lead times so that sufficient advance notice is given to residents and businesses and are usually only applicable to fluvial flooding. In the case of intense, flashy rainfall events, where pluvial and sewer flooding may pose the most risk, flood warnings schemes rarely exist.

The Timperley FSA provides flood storage on Timperley Brook and benefits areas downstream in Broadheath, Woodhouses and Timperley. The Sale Water Park is a much larger flood storage facility located on the River Mersey immediately upstream of the confluence with Chorlton Brook. The Sale Water Park FSA forms part of the Mersey Flood Alleviation Scheme and is carefully controlled and operated in conjunction with the Didsbury FSA upstream in Manchester. It provides benefits to Sale, Ashton-upon-Mersey, parts of Urmston, Flixton and Carrington.

Risk of Failure of Defences and Impacts

Behind defended areas there is a residual risk of 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 tend to be low lying, and the water level will have often built up to a higher level than ground levels of the defended area. The same risks can be associated with reservoir/dam failure, though the risk of such failures is considered to be minimal. Throughout the Mersey, Timperely and Sinderland Brook corridors in Trafford, there are extensive flood defences of varying SoP and condition that provide a level of protection. However, compared to other councils in the AGMA sub-region (for example, Salford), the impacts of defence failure are less severe.

People and Property at risk of flooding

The EA carried out a strategic review of flood risk for the whole of the North West Region56. This looked at the EA Flood Zones and the number of properties at risk of flooding within each District in the North West. Table 9-10 shows the number of properties at risk of flooding in each flood zone.

Table 9-10: Properties at risk of flooding (source: EA Flood Zone Ranking using EA Flood Zones)

FZ3	FZ2&3	FZ1	Total
762	2,577	98,381	100,958

Using census Output Area (OA) data (the smallest census geographical area), and updated mid-term 2005 population estimates for Trafford, the potential populations affected by flooding in the different flood zones are presented in Table 9-11. 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 a district, 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 a CO by the type of accommodation they live in. Again, assuming an even distribution across a CO, an indication as to the predominant types of properties at risk can be shown.

[56] 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)

Table 9-11: Approximate number of people affected by fluvial flooding in Trafford

	Population at Risk (2005)	People living in House Bungalow	People living in Flat or Apartment	People living in Caravans or moveable Accommodation	People living in Shared Dwelling
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

From these coarse statistics, it is can be seen that the majority of people potentially affected by fluvial flooding in Trafford reside in detached houses or bungalows in flood zone 3 and Flood zone 2. There is a large proportion of people shown to be affected in FZ3b due to the fact that for many areas of the District, functional floodplain has not been defined through detailed modelling. As a result, the modelled outlines for FZ3a were used as a proxy.

9.3. Strategic Overview of Flood Risk in Trafford MBC

9.3.1. Consequences of Upstream and Downstream Development

Broad development upstream of Trafford within the Mersey and Irwell catchments is defined within the RSS in terms of housing figures. The districts upstream that are connected to Trafford hydrologically therefore have the potential to adversely affect the current flood risk. 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 13 districts, both within and adjacent to, the AGMA sub-region to affect flood risk in Trafford (Figure 9-2). 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.

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.

Should RSS housing targets be met, for example, a total of 188,300 new homes will be built in districts upstream of Trafford. A further 35,640 homes are proposed in districts downstream of Trafford. These figures are for net new housing and so are additional to the current levels of development. Furthermore, all of the districts within the AGMA sub-region have a high target for development on previously developed land (PDL). As a result, if no measures are taken to control runoff there is a potential for some of the new development to cause an increase in flood risk to Trafford. Trafford has a large housing target (10,400) under the RSS within the sub-region, with much of the proposed development areas either in the Trafford Park Inner Area and the Regional Centre, Davenport Green, Partington and Carrington or centred in and around the urban centres of Altrincham (including Broadheath), Sale and Hale. These areas are also those that follow the River Mersey, Sinderland Brook and MSC corridors and therefore have a potentially higher level of flood risk both currently and in the future.

Downstream and adjacent to Trafford are Manchester CC, Salford CC, Warrington MBC and Macclesfield DC. Development and expansion aspirations within Trafford, as identified above in Section 9.1, are large and ambitious. Forming a part of the Regional Centre and Inner Area (MCR2) in the RSS, which are adjacent to major watercourses, means that development in Trafford has the potential to impact on the flood risk of downstream and adjacent councils.

In reality, however, it is likely that new development will be constructed to modern and sustainable standards following current best practise guidelines and policy (PPS25) and incorporating, where possible, SuDS to limit runoff.

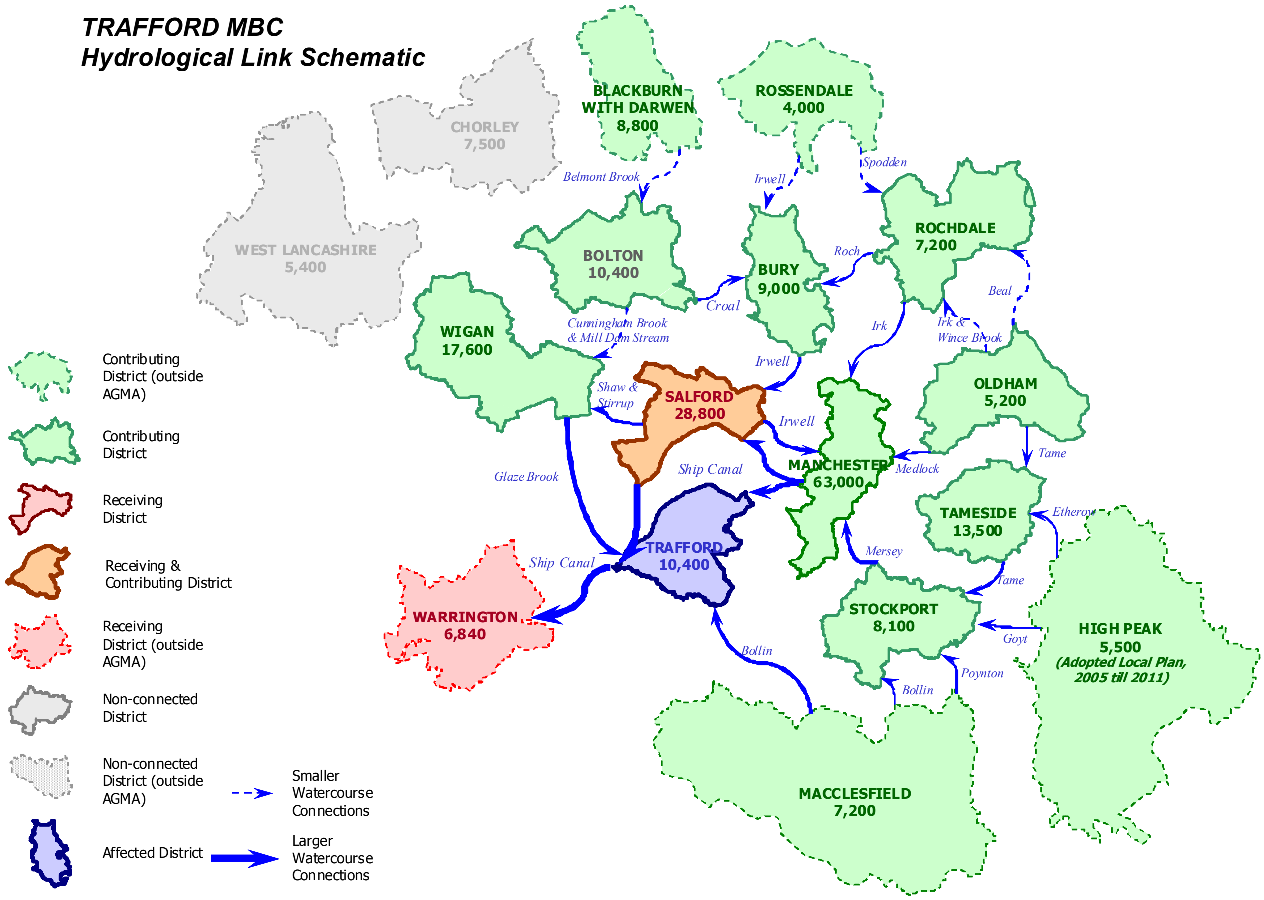


Figure 9-2: Hydrological Links

9.3.2. Potential Conflicts between broad development aspirations and the PPS25 Sequential Test

As highlighted above, the main flood risk to the district is primarily from fluvial sources, in particular the River Mersey. Whilst on a smaller and more localised scale, significant and more frequent flooding problems have also been identified as a result of sewer and drainage issues. In addition, there is, at present, an unquantified risk of flooding from the Manchester Ship Canal and Bridgewater Canal.

As discussed in Section 9.1, much of the primary aspirational development areas – The Regional Centre (including Wharfside), The Trafford Park Inner Area, Partington and Carrington – are located on the southern bank of the Manchester Ship Canal. Similarly, aspirational development areas in Sale, Altrincham and Broadheath are adjacent to the Birdgewater Canal. Though no flooding records exist, there is an inherent potential flood risk from the canals and therefore a potential conflict with the PPS25 sequential test.

The Carrington potential development area is also adjacent to the River Mersey with Broadheath and Partington adjacent to Sinderland Brook. This leads to further potential conflict with the PPS25 sequential test. Furthermore, potential exists for a new Eco-Town in the vicinity of Carrington which will need to consider the potential flood risk from the Ship Canal and the River Mersey.

In addition, the RSS has identified a target of 80% of new development to occur on PDL and outside the large areas of open space within the district. Therefore, there is potential for an increase in the amount of impermeable area and the subsequent increases in runoff and the impacts on surface water and sewer flooding. Using UU data and the Urban Morphology Types (UMT) boundaries from the ASSCUE project the percentage of impermeable areas within the district can be identified and it is recommended that the risks associated with potential surface water (pluvial) and sewer flooding in these areas is examined in more detail at the Level 2 SFRA stage.

Finally, there are some ambitious aspirational infrastructure schemes planned within the district including new crossings over the MSC and an extension to the Metrolink through Trafford Park. 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.

In order to examine these potential conflicts in more detail, it will be necessary to create higher resolution and smaller scale maps showing more detailed flood outlines, taking into account functional floodplain and climate change (as per PPS25 requirements) and displaying the risk associated with the MSC during Level 2 assessments.

9.3.3. Impacts on and from other strategic spatial considerations

Other spatial considerations that Trafford MBC should take account with regards to flood risk include the Greater Manchester Green Infrastructure Scoping Study 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 that the River Mersey corridor through the District is already relatively free of buildings and impermeable areas. Sinderland Brook through Altrincham and Sale is much more urbanised and there are fewer opportunities to increase natural floodplain and storage (though the Timperley FSA is in operation on Timperley Brook). However, it is nonetheless 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.

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.

Waste and hazardous substances can also be released by flooding and potentially introduce harmful and polluting substances into flood waters for transport and distribution elsewhere. The Greater Manchester Waste DPD is currently being undertaken and identifies current and future areas for waste management, storage and transfer. Using this in conjunction with the SFRA may help to reduce the risk of flooding to waste sites. The SFRA should also be used to identify mitigation options for current waste sites within the region so that existing risks of contaminant release can be reduced.

9.3.4. Strategic Effects of Defence failure

As highlighted above, the main watercourses within the District already have extensive raised flood defences. In particular, there are areas along Sinderland Brook through Altrincham and Sale where a residual risk of defence failure exists. Similarly, areas in Carrington, along the River Mersey, are also at potential risk of defence failure. The impacts include fast flowing, deep water through the defended areas.

The failure of the Mersey Flood Alleviation scheme to operate correctly may also adversely impact on the above areas within Trafford. For example, if the Didsbury FSA in Manchester and the Sale Water Park are not operated correctly or fail, there is a potential for increased flood risk downstream.

9.3.5. Identifiable strategic mitigation options

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. Similarly, locating storage facilities too low in the catchment may also have limited benefits and be difficult to locate due to the lack of suitable locations (in terms of topography, urban extent and available land). 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.

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. However, 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. Both the Irwell CFMP and the Salford SFRA recognise that the provision of an additional storage basin just upstream between Salford and Bury could have significant flood risk benefits to Salford and further downstream. The 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 impact on reducing flood risk in Salford. 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. Although the FSA has been identified as primarily benefiting Salford, by reducing the flows travelling downstream, it may also contribute to reducing flood risk in the Ship Canal and therefore benefit Trafford as well.

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

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 Salford, Manchester and Trafford, infiltration SuDS are likely to be most suitable for new development, however the risk of contaminating the underlying aquifers needs to be seriously considered.

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 and restore or create floodplain which further reduce flood risk across catchments.

Trafford_Overview/01

Trafford_Overview/02

Trafford_Overview/03

10. Wigan Metropolitan Borough Council

10.1. Wigan Development and Planning Context

The Metropolitan Borough of Wigan is situated due west of the Greater Manchester conurbation. It is made up of the towns of Wigan, Leigh, Hindley, Ashton-in-Makerfield, Atherton, Tyldesley, Golborne, Pemberton and Standish. In location terms, Wigan is more detached from the Manchester Regional Centre and also has links to the Merseyside sub-region to the west of the conurbation. Its proximity to the M6, M58, M62 and M61 motorways places it at the centre of the regions strategic road network and has good rail links.

There is a population of about 301,417 (source: 2001 Census) across an area of 20,000 ha, Wigan is one of the largest metropolitan districts in England. A map presenting planning information for Wigan is included at the end of this section (Figure Wigan Overview/02).

10.1.1. Strategic and Regional Position

Wigan MBC is one of the Authorities that make up the northern part of the Manchester City Region in the draft RSS and therefore relates to the other Authorities in this grouping, particularly neighbouring Bolton. Wigan also forms a key gateway into and out of Greater Manchester with the M62 and M61 travelling along the southern and north-eastern boundaries of the District. As such, Wigan also relates closely with Salford City Council. Wigan also shares borders with Warrington and St Helens in the south and west and Chorley and West Lancashire in the north. Within the draft RSS, Wigan is not highlighted as a location for any key regionally strategic sites but is considered a key public transport interchange and it clearly sits at the centre (spatially) of the northwest region and therefore can play an important role within the region.

10.1.2. Local Development Framework

Timetable

Wigan's Local Development Scheme (LDS) sets out the timetable for the development of their Local Development Framework (LDF). Both the Core Spatial Strategy and the Site Allocations DPD are currently at the Issues & Options stage and are due to be at Preferred Options stage in mid-2008. All the Greater Manchester Authorities are preparing a Joint Waste DPD, which will be at the 2nd stage Issues & Options Paper in January 2008. The Wigan LDS sets out 7 Supplementary Planning Documents (SPDs), 3 of which have been adopted. The Wigan UDP (2006) has been saved as statutory planning policy for Wigan until the LDF is complete.

Regeneration Activity

Wigan, as an Authority, have received in excess of £20 million in Neighbourhood Renewal Fund allocations since 2001, funding which is to be used to narrow the gap between deprived areas / communities and the rest of society. Locally, the UDP does not highlight any broad locations or focal points for regeneration, but the fact that Wigan is ranked 53 out of 354 in the Indices of Deprivation indicates that parts of the District are in need of regeneration.

Housing Land

Regional Planning Guidance for the North West (RPG 13) required that the District make provision for an annual average build rate of 410 dwellings per year net of clearance. The UDP specifies that this annual rate of provision will apply to 2016 until such time as a different rate is adopted through a review of RSS. The Draft Regional Spatial Strategy (RSS) established a requirement for 900 new dwellings per year net clearance for Wigan but the Panel Review recommended that this be increased to 978 new dwellings for the District.

Table 10-1: Regional Spatial Strategy Targets: 2003 – 2021

	Draft RSS Target	Panel Review Recommended Target
Overall Housing Increase 2003-21	16,200	17,600
Mean Annual Increase	900	978
Indicative Previously Developed Land	80%	80%

The housing trajectory chart below has indicated that more is built in the District than the RPG annual average requirement and that this trend would likely continue. This is based on the amount of dwellings not started on sites under construction, as well as dwellings with planning permission and allocated sites. However, this needs to be considered in the light of the Submitted Draft RSS (January 2006), which significantly increased annual housing figure for the District from the current 410 to 900 or possibly even 978 per annum.

It is assumed that at around 2010/11, the total build rate for the District will drop, reflecting the completion of allocated sites and the slower rate of windfall sites coming forward. At present the District has a good supply of housing land (see Table 10-2) largely within mixed development on safeguarded land and windfall sites but where the supply will be continued beyond 2011 needs to be considered. In light of this it should be remembered that PPS3 requires that LPAs do not rely on windfall sites but that they should be considered for the purposes of the SFRA.

Table 10-2: Housing Supply for Wigan MBC

Housing Supply	No. Dwellings
Dwellings on sites under construction	1,066
Dwellings with planning permission	2,278
Windfall sites	3,612
Dwellings from conversions and change of use	1,050
Dwellings from mixed-use allocations	1,034
HOUSING SUPPLY TO 2016	**9,040**

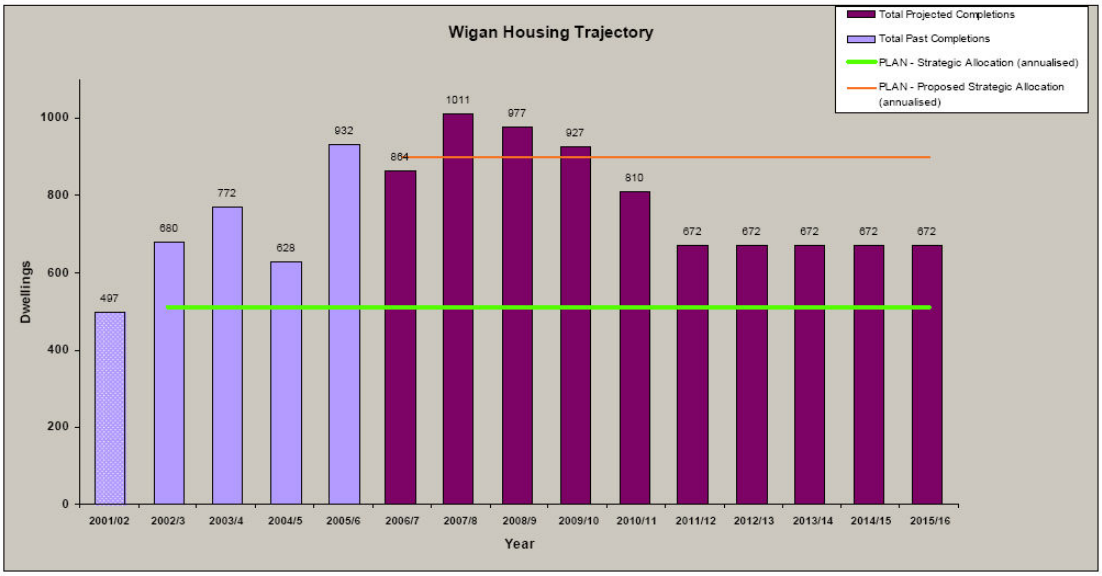


Figure 10-1: Housing Trajectory

Employment Land

The UDP proposes to identify 255ha of land for employment purposes (Policy EM1) to 2016. This is based on 15.4 ha per annum plus 20% for flexibility. Much of this can be found within the Primary Employment Areas (Policy EM1A). The total area of the Primary Employment Areas is 790 ha, of which 201 ha are available for development (Table 1 on p.34 of the UDP). This differs from the figures put forward in Table 1 of the AMR (2006, p.12), which identifies 187.66 ha of available employment land, 17.39 ha of which has planning permission.

However, whichever figures are used, it is clear that Wigan has sufficient employment land available for the next eight years and, while there are no proposals for significant extension to urban areas at present, there are substantial amounts of employment land that may come forward for development at some future time beyond 2016, if it is required.

Transport Infrastructure

Wigan is considered a key regional public transport interchange and lies at the heart of the northwest region's motorway network, with easy access to all parts of the region. In terms of public transport, Wigan has good connections to Manchester City Centre, Salford and Bolton via rail connections and from Manchester City Centre to the rest of Greater Manchester.

The Authority has long term aspirations to construct the A49 Diversion, a strategic east-west trunk road linking the M6 on the west of the District with the M61 on the east. The overall scheme is at varying stages of delivery however, Council planners are proposing a section of the A49 diversion, from Goose Green to Westwood Park, a major new employment site

10.2. Wigan Flood Risk Summary

10.2.1. Hydrological background: catchment and watercourse network

The District of Wigan lies within the Greater Manchester SFRA area. . A large part of the District is drained by the River Douglas and the extreme southern area of Wigan is drained by the Glaze Brook catchments. Wigan is situated within the upper and middle reaches of the Douglas and contains some of the headwaters of Glaze Brook, along with numerous smaller watercourses as shown in Table 10-3. All of these watercourses carry with them an inherent potential flood risk. . The Leeds-Liverpool canal also flows through the District and is carried underneath the Douglas in Wigan via the Green Street Siphon. Two CFMPs cover the District, the draft Mersey Estuary CFMP which covers the extreme south of the District, and the River Douglas CFMP which covers the remaining area. Together the CFMPs provide a catchment wide assessment of flood risk, and can be used as a tool to aid planners strive towards sustainable development. Table 10-3 shows the main watercourses and urban areas at risk of flooding from each.

Table 10-3 Main Watercourses and Urban Areas at Risk

Main Watercourses	Urban area at risk
Douglas	Wigan
Hawkley Brook	Wigan
Ince Brook	Wigan, Ince in Makerfield
Smithy Brook	Wigan
Calico Brook	Shevington, Shevington Vale
Worthington Lakes	Standish
Collier Brook, Westleigh Brook	Leigh
Tyldesley	Tyldesley
Glaze Brook	Glazebury
Carr Brook	Lowton
Pennington Brook	Lately Common
Hey Brook	Abram
Borsdane Brook	Hindley
Brookdale Brook	Bickershaw
Rindle Brook	Platt Bridge
Pen Leach	Bedford and Lilford
Millingford Brook	Ashton in Makerfield

10.2.2. Historical Flooding

A review of the information supplied by the Council, the EA, CFMP's, and through searching online historical records[57], has revealed that Wigan has experienced a number of flood events throughout the last century. Historically the District has experienced river flooding predominantly from the Douglas, surface water flooding, and sewer flooding. The historic records of flooding show that the District is vulnerable to both periods of prolonged rainfall in the autumn and winter months mainly leading to fluvial flooding, and local flash flooding primarily of surface water caused by intense summer downpours in urban areas such as Wigan and Hindley. Recorded flood events have occurred most frequently from mid summer through to the end of autumn. Table 10-4 shows a number of significant historical flood events.

Table 10-4: Significant historic flood events

Date	Location	Source of Flooding	Impact	Source of Information
November 1866	Wigan	Fluvial flooding from the Douglas	Localised flooding	BHS Database
July 1909	District wide	Heavy rain lead to flooding from the Douglas and Glaze Brook	Widespread flooding	BHS Database
August 1912	Wigan	Overtopping from the Douglas	Localised flooding	BHS Database
September 1922	Hindley	Borsdane Brook burst its banks	Localised Flooding	BHS Database
November 1925	Wigan	Overtopping of the Douglas	Localised flooding	BHS Database
December 1936	Newtown	Overtopping from Douglas	Localised flooding	BHS Database
February 1966	Wigan, River Douglas		Flooding in Water Hayes, Scholes, Poolstock, Bus station	BHS Database
November 2000	Wigan	1 in 25 -1 in 40 yr event Leaking defences Overtopping of defences	Eleanor St flooded, evacuations, Scholes area flooded, bus depot flooded	Wigan MBC records
June 2002	Wigan	Sewer Flooding	1000 properties flooded	Report on Flooding by the Overview and Scrutiny Committee
November 2004	Wigan, River Douglas	Overtopping of Douglas	Damage to parked cars, Asda	Wigan MBC records
October 2004	Standish, Abram, Golborne, Haigh	Heavy rainfall led to flooding from Glaze Brook and sewer flooding	Flooding of highways, homes and gardens	Wigan MBC records
August 2004	Wigan, Tyldesley, Astley, Ashton, Hawkley, Goose Green, Leigh, Hindley.	Intense rainfall led to flooding from River Douglas, Hawkley Brook, Calico Brook, Westleigh Brook. Sewers also flooded	Eleanor St flooded	Wigan MBC records

57 British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe/

10.2.3. CFMP Assessment of Flood Risk

The District is covered by the draft Mersey Estuary and River Douglas CFMPs. Draft policies are subject to change and the SFRA must be adapted accordingly. CFMP's have split overall flood risk in the District into the five units displayed in Table 10-5. The River Douglas and Mersey Estuary CFMPs have assessed the level of flood risk in each of the policy units defined within them, as being high, medium or low, and this is also displayed in Table 10-5. The CFMPs have also recommended a preferred policy option number for each unit. The generic policy options are shown in Table 10-6.

Table 10-5: Policy Units and preferred policy in Wigan

Policy Unit Name as in CFMP	Preferred Policy	CFMP	Risk
2: Fluvial River Douglas and its tributaries	4	Douglas	Main risk is from river flooding. Risk is currently medium.
5:Built up areas	4	Douglas	Risk is from rivers, surface runoff, drainage and culvert blockage. Risk is currently medium.
7:Wigan, Croston and Appley Bridge	5/6	Douglas	Flood risk currently high in Wigan. Main risk is from river flooding but also a risk from drainage/culvert blockage and flow restriction.
1: Glaze	2	Mersey Estuary	Overall current flood risk is low, higher risk within the Glazebrook
2: Leigh	5	Mersey Estuary	Overall risk in this area is low
3: St Helens (+Ashton in Makerfield)	3	Mersey Estuary	Overall risk is low

Table 10-6:Generic CFMP Policies

Policy 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)

10.2.4. Current and Future Flood Risk in Wigan MBC

Identification of Flood sources

Flooding from Rivers

The historic flood event search, the EA, the City Council, and the CFMPs all indicate that the main flood risk within the District is flooding from rivers. Flood risk is highest in the north of the District in the Douglas catchment, and in the Bedford area in the south of the District. The upper reaches are susceptible to short-term intense rainfall events such as thunderstorm activity where large volumes of water are confined to relatively narrow river valleys. The lower reaches of rivers in the catchment tend to be at risk from fluvial flooding attributed to prolonged rainfall activity as the naturally flatter topography drains a larger catchment area. Areas surrounding confluences of tributaries and main channels such as the Poolstock area of Wigan where Smithy Brook and the Douglas converge, have an increased flood risk, particularly if flood peaks on both watercourses coincide or flow exceeds culvert capacity. The main urban areas of fluvial flood risk in the District are Wigan and Hindley. Flooding due to flow restrictions, which can be attributed to sedimentation and blockage of structures and weirs is a risk. This type of flooding is primarily found upstream of structures when water backs up behind the blockage and ultimately overtops the channel. The River Douglas CFMP58 notes that the Green Street Siphon that carries the River Douglas beneath the Leeds-Liverpool canal in Wigan town centre is known to be partly blocked but thought to be stable.

Whilst fluvial flooding poses a significant to the District, 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.

Flooding from the Land

During periods of prolonged rainfall activity and sudden intense downpours, overland flow from adjacent higher ground may ‘pond’ in low-lying areas of land without draining into watercourses or 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.

Flooding from Sewers

Sewer flooding is another flood risk throughout the District, particularly during storm events where there is insufficient capacity in the drains and sewers to cope with high volumes of water. The drainage system and sewers become overwhelmed by the volume of water and start to surcharge. During periods of high river flow, there is the potential for such drainage systems to become ‘tide

[58] River Douglas CFMP March 2007(draft)

locked' and unable to discharge to the watercourse. The water then backs up and will again start to discharge. Sewer flooding was identified using historical records from United Utilities DG5 database (June 2007) detailing the total number of flood events that affected both internal and external property. Sewer flooding is known to have repeatedly occurred in Wigan, Golbourne, Tyldesley, Astley, Ashton, Hawkley, Goose Green, Leigh, Hindley and Abram. Wigan has one of the highest recorded rates of sewer flooding in the AGMA sub-region with 59 internal and 224 external recorded events according to the DG5 dataset (Figure 10-2).

It should be noted that much of the sewer network is though to date 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 this design standard is not achieved. It is therefore likely that much 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.

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 that is also covered by the Data Protection Act (1998). As a result, a detailed analysis of the scale and consequences of sewer flooding has not been possible at this stage of the SFRA.

However, during the course of this sub-regional study, 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 and AGMA have agreed to share data on drainage and development areas initially for Bury and Salford. This will allow both UU and AGMA to determine the usefulness of the data and to agree how it can be spatially represented on a sub-regional and strategic basis for the whole of the AGMA area. It is anticipated that both UU and AGMA will have agreed the scale and format of the data in time for more detailed Level 2 SFRAs.

Flooding from Reservoirs, Canals and Artificial Sources

There are a number of reservoirs upstream of the District. Reservoirs have an attenuating effect on flood flows. Reservoirs do however have a flood risk associated with them in terms of dam/reservoir wall failure and emergency releases into the catchment. The likelihood of this occurring is minimal but impacts are potentially extremely high due to the limited warning time available and the potential high velocity and high volume flows.

The Leeds to Liverpool Canal runs through the District. There are few recorded instances of flooding from the canal networks as they tend to be heavily regulated and controlled. One such instance reportedly occurred in the Poolstock Street area in 2007 when water overtopped the canal and caused some highway flooding. Nonetheless, flood risk from canals and navigable waterways still remains where water levels could overtop or breach embanked sections. Nonetheless, flood risk from canals and navigable waters still exists where canals could overtop or breach. This risk is difficult to quantify however, and both BW and MSCC are currently reviewing the information they hold with regard to flood risk to determine the most suitable way of presenting and using the data. It is anticipated that more details will be available for the Level 2 SFRAs. . The Leeds-Liverpool Canal an additional potential flood risk, particularly in Wigan town centre where the canal is higher than surrounding properties in many places.

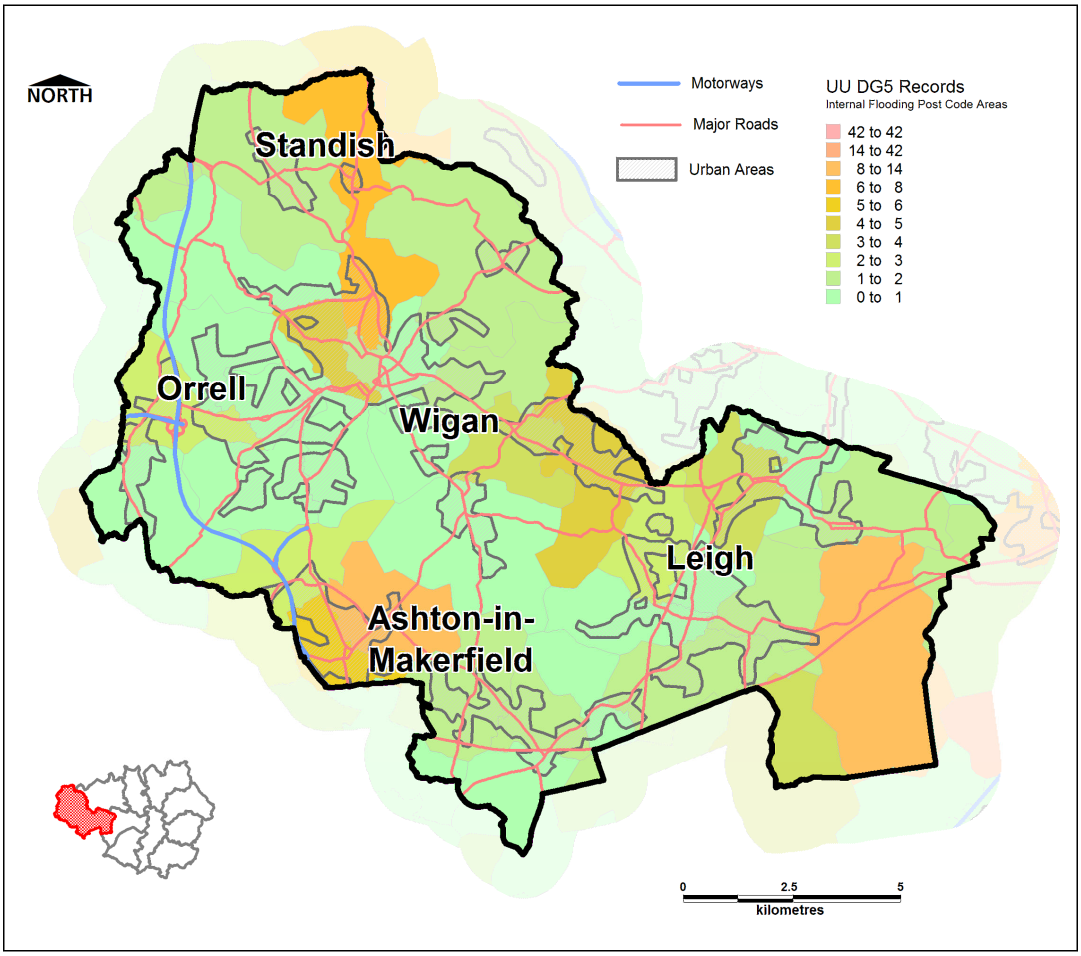


Figure 10-2: UU DG5 data (June 2007) showing instances of Internal Flooding in Wigan MBC by five-digit postcode area.

Flooding from Groundwater

British Geological Survey (BGS) Maps show the southern area of the council to be underlain by more permeable rocks consisting primarily of mudstones, siltstones and sandstones. As a result, the EAs groundwater vulnerability maps show that much of the southern extents of the District are classed as a Major and Minor Aquifers (consisting primarily of the Sherwood Sandstone Aquifer).

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 no reported incidents of groundwater flooding in the District. However, work undertaken by DEFRA and the EA[59] has shown that flooding from groundwater is shown to become a potential issue in the Glaze catchment due to the cessation of dewatering in mines,

Searches revealed relatively few reported incidents of groundwater flooding in the District. However, work undertaken by DEFRA and the EA has shown that flooding from groundwater is shown to become a potential issue in the southern extents of Wigan due to the cessation of dewatering mines including Tyldesley and Leigh. During coal mining operations, the area was extensively dewatered, however, since coal mining in the area ceased, groundwater levels have risen. According to the EAs water resources team and groundwater monitoring data, the risk posed by localised groundwater flooding is likely to remain remote. However, this could become more of an issue in certain areas of the district due to the rising groundwater levels and the major aquifer – especially those abutting watercourses where local groundwater levels may be influenced by rivers and canals.

The impacts of increased development in these areas must therefore 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.

Fluvial Flood Zones

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 and each outline used to create the SFRA flood zones assumes that no defences exist. There are no areas of tidal flood risk within the AGMA sub-region.

[5959] Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (LDS 23) 2004

However, there are areas where little or no accurate flood outlines exist, and therefore, to ensure a continuous coverage across a flood zone, less accurate, broad-scale modelled (the EA J-FLOW Flood Zones) outlines were used instead. This hybrid approach provides a conservative flood zone and highlights potential uncertainties that can either be resolved in more detail at Level 2, or by developers as part of site-specific FRAs. The SFRA has identified the following flood zones in accordance with PPS25:

Flood Zone 1: Low Probability of Flooding
Land having a less than 1 in 1000 annual probability of river 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%) in any year. No detailed modelled outlines exist for Flood Zone 2 in the Wigan Area. Therefore the EA broad-scale Flood Zone 2 maps were used.

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

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. Where possible, 1:20 or 1:25 year detailed modelled outlines were used to define the functional floodplain. Some defended areas may include flood storage basins which are by their very nature functional floodplain. 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 in the data and potential tasks for the more detailed Level 2 assessments. 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.

Using the Flood Zone maps, the total area of Wigan at risk of fluvial flooding can be determined. Table 10-7 and Figure A-5 (Appendix A) show that significant areas of the district are at risk of fluvial flooding, with approximately 7% of the district area affected by Flood Zones 2 and 3.

Table 10-7: Area of Fluvial Flood Risk to Wigan MBC

District Area (ha)	Urban Area (ha)	Fluvial Flood Zone	Area (ha)	% (of District or Urban Area)
18,757.90	4,513.20	FZ3b	707.59	3.77
		FZ3a	121.45	0.65
		FZ3 in Urban	150.61	3.34
		FZ3 + CC	549.27	2.93
		FZ2	549.27	2.93
		FZ2 in Urban	179.22	3.97

Note: Figures for FZ3a refer to the area outside of FZ3b, figures for FZ3+CC and FZ2 refer to the area outside of FZ3a.

Flood Zone Confidence

Flood Zone Confidence Maps are intended to be used by planners as a tool for identifying areas of high, medium or low confidence in the data that has been used to derive fluvial Flood Zones across the sub-region and also to determine where further work is required. The confidence assigned to a Flood Zone demonstrates the level of detail and the number of assumptions made when deriving the Flood Zones. The maps can be used to determine reaches of river where further, more detailed work is required to refine Flood Zones and therefore where resources should be directed.

Table 10-8 illustrates the confidence assigned to the Flood Zones present within the Wigan MBC district. A map showing confidence in the each of the Flood Zones is presented at the end of this section (Figure Wigan Overview/03).

Table 10-8: Fluvial Flood Risk Confidence for Wigan MBC

District	Fluvial Flood Zone	Watercourse	Settlement	Source	Date of Modelling Study	Confidence
Wigan	3b	River Douglas, Smithy Brook, Hawkley Brook	Wigan	Douglas S105 Model	2003 (May 2008)	High
			Ince-in-Makerfield			
		All Other Watercourses	Ashton-in-Makerfield	EA Flood Zone Maps	NA (May 2008)	Low
			Golborne			
			Wigan			
			Hindley			
			Abram			
			Atherton			
		Calico Brook	Arpley Bridge	Yarrow, Lostock, Douglas, Calico Brook	2003 (May 2008)	High
		Westleigh Brook, Hindsford Brook, Old Mill Brook, Atherton Lake Brook, Pen Leach Brook, Lilford	Leigh	Middle Lower Mersey Model	2001 (May 2008)	High
			Tyldsley			

		Park Brook				
	3a	All Other Watercourses	Ashton-in-Makerfield Golborne Wigan Hindley Abram Atherton	EA Flood Zone Maps	NA	Medium
		Westleigh Brook, Hindsford Brook, Old Mill Brook, Atherton Lake Brook, Pen Leach Brook, Lilford Park Brook	Leigh Tyldesley	Middle Lower Mersey Model	2001	High
		River Douglas	Wigan	Douglas S105 Model	2003	High
	3a + CC	All Other Watercourses	Ashton-in-Makerfield Golborne Wigan Hindley Abram Leigh Atherton Tyldesley	EA Flood Zone Maps - Flood Zone 2	NA	Low
	2	All	Ashton-in-Makerfield Golborne Wigan Hindley Abram Leigh Atherton Tyldesley	EA Flood Zone Maps	NA	Medium

Climate Change and Future Flood Risk

The CFMP's have 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 District. Defra/UKCIP (United Kingdom Climate Impacts Programme) 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. Flows at the 10%, 1% and 0.1% event were modelled. Results showed an average of an increase in flows of 25% across the Douglas, Glaze Brook and Sankey catchments.

The Douglas catchment is shown to be sensitive to changes in agricultural drainage and intensification. It has been shown to be marginally sensitive to urban development due to limited opportunity. The Glaze and Sankey catchments were shown to be most sensitive to urban development with increases in flows of up to 25%. Table 10-9 based on information in the draft Mersey Estuary CFMP[60], shows how flooding depths and numbers of properties at risk of flooding can potential.

Table 10-9: Urban Area and depth of flooding for Wigan MBC (Mersey Estuary CFMP)

Urban Area	Base flood depth	2055 depth	2015 depth	Base property at risk	2055 property at risk	2105 property at risk
Leigh	1.3	1.5	1.5	346	445	457
Hindley	2.4	2.4	2.6	1373	1412	1470
Ashton in Makerfield	1.5	1.56	1.58	307	324	329

The flood extent in the Douglas catchment was shown to be similar to the current flood extent under all scenarios, though there was a notable increase in extent in Wigan. Flood depths increased by an average of 0-5cm. Across the District an average increase of 5% more people will be affected by flooding. The largest increases in property at risk are in the lower reaches of Glaze Brook and Hindley. Flood extent and depth were shown to increase across the Glaze Brook and Sankey catchments.

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)[61] 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 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. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

The location of future urban developments and flood defences within a catchment can influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments. It may however be possible to mitigate against this 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.

To account for Climate Change at the sub-regional level, 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

[60] Draft Mersey Estuary CFMP March 2007
[61] 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

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 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 Level 2 stage or during Site Specific FRAs. The location of future urban developments and flood defences within a catchment has the potential to further increase flood risk at sites downstream of such developments. It may however be possible to mitigate against this risk through development design and/or development of compensatory storage and flood storage basins.

Work undertaken by DEFRA and the EA has shown that flooding from groundwater is shown to become an issue in the Glaze catchment in particular in areas including Tyldesley and Leigh. The primary reason for potential increase in groundwater flood risk is due to the cessation of dewatering in mines, and geological and groundwater vulnerability maps showing the area to be underlain by permeable rocks.

In addition, UKCIP[62] suggests that increased temperatures and drier summers attributed to climate change could lead to an increase in subsidence risk. This is potentially problematic for Wigan given its history of mining subsidence and development of ‘flashes’ such as Pennington Flashes following water infilling the sinking land causing flash floods.

Flood Risk Mitigation and Management

Flood Risk Management

Flood risk management assets may be hard formal structures designed for purpose such as flood walls, or they may be informal structures such as garden walls which were not designed specifically as defence structures, but are now performing that role. The National Flood and Coastal Defence Database (NFCDD) identifies any asset (including channels) that may have an impact on flood risk management and is constantly being updated and amended by the EA as a result of ongoing asset inspections. It should be noted that the database assigns a Standard of Protection (SoP) to flood defence assets and has a default value of 50 Years. Therefore the SoP values should be treated with caution and assessed (in conjunction with the EA) on a site-by-site basis during the more detailed Level 2 stage. NFCDD data, along with CFMP’s and council supplied information, have been used to identify the following major structures and flood defences assets in the District.

- Lilford Park Flood Storage basin
- Bedford Pumping station
- Pennington Pumping station

[62] Climate Change and Local Communities: How prepared are you? An adaptation guide for local authorities in the UK, UKCIP, July 2003

- Culverts: numerous on all watercourses
- Weirs: numerous
- Green Street Siphon Leeds- Liverpool Canal, Wigan
- Rivington Reservoir
- Worthington/Arey/Ardlington system
- Leeds-Liverpool Canal

By interrogating NFCDD outputs, a series of informative statistics about flood risk assets can be obtained. For Wigan MBC, data from NFCDD shows that there are over 14km of culverted watercourses and only 2km of raised defence having an SoP of between 21 and 50 years (Table 10-10).

Table 10-10: NFCDD data summarising lengths of flood defence asset in the Wigan MBC Area (km) by Standard of Protection (return period in years).

Asset Type	Length of FRM Asset (km) by Standard of Protection in years					
	Unclassified	0-20	21-50	51-75	76-100	Total
Culverted Channel	0.08	0.11	13.75	0.08	0.28	14.22
Maintained Channel		0.00	0.13	0.00	0.00	0.13
Natural Channel		1.29	34.79	0.90	0.00	36.98
Flood Defence Structure		1.03	21.71	4.63	0.39	27.76
Non-Flood Defence Structure	0.02	0.05	0.84	0.01	0.10	1.00
Raised Defence (Man-Made)		0.00	2.04	0.00	0.00	2.04
Total		2.47	73.26	5.61	0.78	82.12

Mitigation

There are many different types of flood risk mitigation actions ranging from small, single dwelling flood proofing measures to flood warning services to large multi-million pound flood defence schemes.

The Flooding Report by the Overview and Scrutiny Committee identifies a number of mitigation measures that could lessen the flooding problem in Wigan. These include:

- The EA approved flood storage structure at Water Heyes

- Improvements to sewerage capacity in the Ashton area

- Gully cleaning

There are flood warning areas in the Glaze Brook covering the Leigh and East Wigan area and Penleach Brook, and also on the River Douglas at Wigan area which have been an effective mitigation measure for many years. However, flood warnings tend to work most effectively during large events with long lead times so that sufficient advance notice is given to residents and businesses and are usually only applicable to fluvial flooding. In the case of intense, flashy rainfall events, where pluvial and sewer flooding may pose the most risk, flood warnings schemes rarely exist.

Risk of Failure of Defences and Impacts

Behind defended areas there is a residual risk of flooding, primarily through overtopping of defences and breaching or structural failure of defences. The same is true of reservoir/dam failure and there are several reservoirs within and upstream of the District. Such failure of defences can lead to an area experiencing rapid and deep inundation as areas behind defences tend to be low lying, and the water level will have often built up to a higher level than ground levels of the defended area.

People and Property at risk of flooding

The EA carried out a strategic review of flood risk for the whole of the North West Region63. This looked at the EA Flood Zones and the number of properties at risk of flooding within each District in the North West. Table 10-11 shows the number of properties at risk of flooding in each flood zone.

Table 10-11: Properties at risk of flooding (source: EA Flood Zone Ranking using EA Flood Zones)

FZ3	FZ2+3	FZ1	Total Properties
3,888	7,915	132,917	140,832

Using census Output Area (OA) data (the smallest census geographical area), and updated mid-term 2005 population estimates for Bolton, the potential populations affected by flooding in the different flood zones are presented in Table 10-12. 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 a district, 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 a OA by the type of accommodation they live in. Again, assuming an even distribution across a OA, an indication as to the predominant types of properties at risk can be shown

[63] 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)

Table 10-12: Approximate number of people affected by fluvial flooding in Wigan

	Population at Risk (2005)	People living in House Bungalow	People living in Flat or Apartment	People living in Caravans or moveable Accommodation	People living in Shared Dwelling
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

10.3. Strategic Overview of Flood Risk in Wigan MBC

10.3.1. Consequences of Upstream and Downstream Development

Broad development upstream of Wigan within the Douglas and Glaze catchments is defined within the RSS in terms of housing figures. The districts upstream that are connected to Wigan hydrologically therefore have the potential to adversely affect the current flood risk in Wigan. As the District is located towards the upstream extent of the Douglas and Glaze catchments there is potential for development in Districts within and adjacent to, the AGMA sub-region to affect flood risk in Wigan. The main potential adverse impacts that future development may have on downstream areas is twofold:

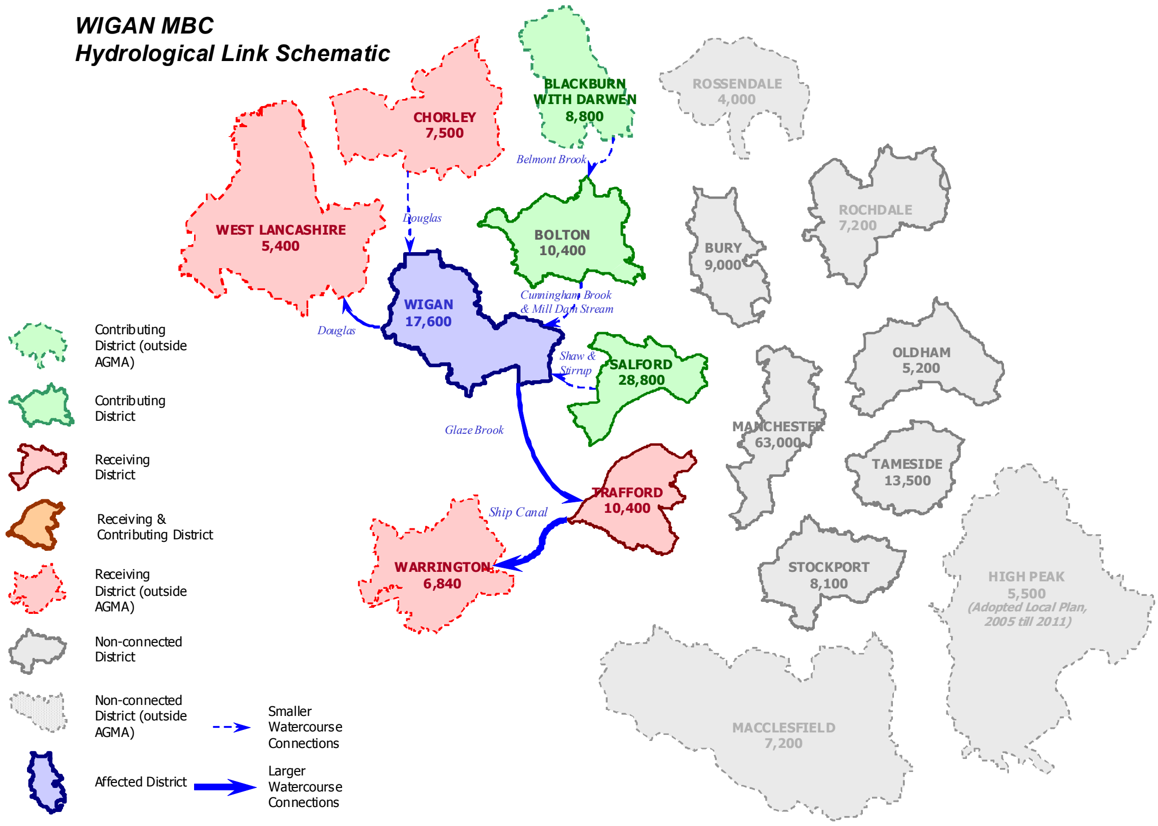
Reduction in Floodplain: Unrestricted development in floodplains can reduce the natural flood storage capacity of a river and, consequently, convey more water downstream.

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.

Should RSS housing targets be met, for example, a total of 46,700 new homes will be built in districts upstream of Wigan, whilst 22,640 will be built downstream of Wigan (Figure 10-3). These figures are for net new housing and so are additional to the current levels of development. Furthermore, all of the districts within the AGMA sub-region have a high target for development on previously developed land (PDL). As a result, if no measures are taken to control runoff from new development, there is the potential for an increase in flood risk to Wigan. In reality, however, it is likely that much of the new development will be constructed to modern and sustainable standards incorporating, where possible, SuDS to limit runoff.

Downstream and adjacent to Wigan are, W. Lancashire, Trafford MBC, and Warrington MBC. Much of the District drains to the North and West into the Douglas Catchment, or South and East into the Glaze Catchment. As a result, Wigan has relatively little hydrological impact on the other councils within the AGMA sub-region. Within the draft RSS, Wigan is not highlighted as a location for any key regionally strategic sites but is considered a key public transport interchange and it clearly sits at the centre (spatially) of the northwest region and therefore can play an important role within the region. Development in Wigan does however have the potential to impact on the flood risk of downstream and adjacent districts. To avoid reducing floodplain storage and potentially increasing flood risk downstream, development within and adjacent to these areas must be undertaken carefully so as not to adversely affect flood storage or flood flow routes. In addition, the incorporation of green open spaces and SuDS measures may help to reduce increased runoff.

Figure 10-3: Hydrological Links for Wigan MBC



10.3.2. Potential Conflicts between broad development aspirations and the PPS25 Sequential Test

As highlighted above, the current flood risk to the district is primarily from fluvial sources, in particular the River Douglas and Glaze Brook. In addition, there is, at present, an unquantified risk of flooding from the Leeds-Liverpool Canal. Most of the proposed development areas are concentrated in Wigan and Leigh where large tracts of potential development are situated within flood zones 2 and 3.

Most of the proposed development areas, include some of the most densely populated areas in Wigan. Therefore, there is potential for an increase in the amount of impermeable area and the subsequent increases in runoff and the impacts on surface water and sewer flooding. Using UU data and the Urban Morphology Types (UMT) boundaries from the ASSCUE project the percentage of impermeable areas within the district can be identified and it is recommended that the risks associated with potential surface water (pluvial) and sewer flooding in these areas is examined in more detail at the Level 2 SFRA stage.

There are some ambitious aspirational infrastructure schemes planned within the district including the Leigh Guided Bus way. 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.

As a result, potential conflicts exist between development and the PPS25 Sequential Test in these areas. In order to examine these in more detail, it will be necessary to create maps showing more detailed flood outlines taking into account functional floodplain and climate change (as per PPS25 requirements) and displaying the risk associated with the Leeds to Liverpool Canal during Level 2 SFRAs.

10.3.3. Impacts on and from other strategic spatial considerations

Other spatial considerations that Wigan MBC should take account of with regards to flood risk include the Greater Manchester Green Infrastructure Scoping Study 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 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.

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.

Waste and hazardous substances can also be affected by flooding and potentially introduce harmful and polluting substances into flood waters for transport and distribution elsewhere. The Greater Manchester Waste DPD is currently being undertaken and identifies current and future areas for waste management, storage and transfer. Using this in conjunction with the SFRA may help to reduce the risk of flooding to waste sites.

10.3.4. Strategic Effects of Defence failure

Impacts of defence failure include fast flowing, deep water which has the potential to cause major damage and loss of life within the District. At this time, it is not thought that the impacts of defence failure in Wigan will adversely impact on districts downstream.

The Overview and Scrutiny Committee report into flooding has identified that at times the storage capacity of the Lilford Park Basin is insufficient to cope with high volumes of flood water and also that Bedford pumping station at times is overwhelmed by the volume of flood water as the Bedford basin is relatively small leading to localised flooding in downstream of the Green Bridge area.

10.3.5. Identifiable strategic mitigation options

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 catchment is reduced. Furthermore, and working closely with the outputs from the current sub-regional Green Infrastructure study, careful land use planning and the gradual reinstatement of green open spaces together with wetlands and woodlands throughout the catchment may help to further reduce runoff.

Wigan_Overview/01

Wigan_Overview/02

Wigan_Overview/03