DERBY CITY COUNCIL

Derby City Council
Preliminary Flood Risk Assessment

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Council

Derby City Council,
Saxon House,
Heritage Gate,
Derby,
DE1 1AN

Authors

Mark Holden-Brown
Nick Tolley

JOB NUMBER: LD10055		DOCUMENT REF: LD10055 DRAFT June '11.doc				
Revision	Description	Originated	Checked	Reviewed	Authorised	Date
01	Draft	MRHB	NT	DP		

EXECUTIVE SUMMARY

This report and associated spreadsheet have been prepared by Derby City Council (DCC) to deliver the requirements of the Flood Risk Regulations (2009). DCC are defined as a Lead Local Flood Authority (LLFA) under the regulations. This report represents the first stage in an ongoing process to record and monitor flooding in Derby.

The Preliminary Flood Risk Assessment (PFRA) report is a high level assessment of flood risk arising from surface water, groundwater, ordinary (not main) watercourses, and canals. Coastal areas, main rivers and reservoirs are specifically excluded from the scope as these are covered under separate assessment.

The PFRA process has been used to record the extent and severity of past flooding events and to measure them against nationally determined criteria as set out by the Department for Environment, Food and Rural Affairs (DEFRA). The predetermined indicative flood areas are based upon a network of 1km grid squares with a future flooding potential of 30,000 residents for a 1 in 200 chance event. For past flooding event this record is to be reduced by an order of magnitude (i.e. reduced to 3000 residents).

It has been determined that, although Derby has a recognised history of flooding, it does not feature in any of the nationally determined Indicative Flood Risk Areas.

Future flood risk was also determined based upon the Environment Agency (EA) Flood Maps for Surface Water (FMfSW) and the National Receptor Property Dataset (NRPD). It was similarly determined that Derby does not fall into any of the nationally determined future flood areas. It is apparent that for a 1 in 200 chance (0.5% probability) event, the number of residents at risk of flooding to a depth in excess of 300mm (0.3m) will be 13,600 which is less than the minimum required for recognition.

Derby does have certain “at risk” areas, which are to be monitored and reviewed as part of an ongoing process.

The PFRA process is to be repeated at regular intervals, in order to assess the change of flood risk with time and also to model how infrastructure improvements reduce this liability.

GLOSSARY

DCC	Derby City Council
LLFA	Lead Local Flood Authority
PFRA	Preliminary Flood Risk Assessment
NRD	National Receptor Dataset
STW	Severn Trent Water
EA	Environment Agency
SFRA	Strategic Flood Risk Assessment
SWMP	Surface Water Management Plan
SuDS	Sustainable urban Drainage Systems
AStSWF	Areas Susceptible to Surface Water Flooding
FMfSW	Flood Maps for Surface Water
GIS	Geographic Information System
LIDAR	Light Detection and Ranging
DEFRA	Department for Food and Rural Affairs
WAG	Welsh Assembly Government
UKRLG	United Kingdom Roads Liaison Group
PPS25	Planning Policy Statement 25
Fluvial	Directly associated with a stream, brook or river
Pluvial	Directly associated with Rainfall
Ordinary Watercourse	Any stream, brook or river NOT considered to be main river – management of the banks will be by those people or companies whose land directly abuts the watercourse (called Riparian Ownership)
Main River	Any stream, brook or watercourse for which the Environment Agency is the managing authority

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1 Introduction

This report and associated spreadsheets have been prepared by Derby City Council to fulfil the requirements of the Flood Risk Regulations (2009) for the provision of a Preliminary Flood Risk Assessment (PFRA). As a Lead Local Flood Authority (LLFA) Derby City Council (DCC) is responsible for the identification and assessment of surface water flood risk within the city, and based upon this assessment, the preparation of management plans to alleviate the resulting hardship and loss of property.

1.1 Overview of Flood Risk Regulations

On 6 November 2007 the European Commission published Directive 2007/60/EC known as the Floods Directive. Its aim was to reduce and manage the risks that flooding poses to human health, the environment, cultural heritage and economic activity. The Directive requires Member States to first carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding.

The Directive was brought into UK law through the Flood Risk Regulations (2009)[(1)]. These regulations outline the roles and responsibilities of the various authorities consistent with the Flood and Water Management Act 2010[(2)] and provide for the delivery of the outputs required by the directive. The Regulations:-

- Give responsibility to the Environment Agency to prepare Directive deliverables, namely; a preliminary assessment report; flood risk maps and hazard maps; and flood risk management plans for flood risk from the sea, main rivers and reservoirs.
- Give responsibility to LLFA's to do the same for 'Local Flood Risk', which includes surface runoff, groundwater and ordinary watercourses.
- Give responsibility to the Environment Agency for collating and publishing the preliminary assessment reports, flood risk maps and hazard maps, and flood risk management plans.

1.2 Scope of the PFRA

The PFRA is a high level assessment of flood risk at a local level for flooding from sources other than the sea, main rivers and reservoirs which are being assessed by the Environment Agency.

The main sources of flooding to be assessed by the PFRA are therefore:

- Surface runoff
- Groundwater
- Ordinary watercourse
- Artificial water bearing infrastructure e.g. sewers, canals etc.

For each of these potential sources, a combination of past records and future predictions will be used to determine the overall flood risks to the residents and businesses of Derby, and to outline the consequences of such an occurrence.

1.3 Aims and Objectives

The aim of the PFRA is to undertake an assessment of local flood risk within the confines of the city boundary with respect to past flooding and the potential harmful consequences of future flooding.

The main objectives are to:-

- Collate information, map and assess past flooding
- Collate relevant data, map and assess the potential of future flooding
- Use collated information to determine areas within Derby that are at significant flood risk.
- Enter all relevant information in the Preliminary Assessment Report for submission to the Environment Agency

1.4 Study Area

The city of Derby covers an area of some 30 sq. miles and has a population of approximately 244,000[3]. It is situated on the banks of the River Derwent just to the north of its confluence with the River Trent, the influence of this union dominates the topography of the city.

The R. Derwent enters the city from the north in a steep sided relatively narrow valley, with the high ground of Darley Abbey and Allestree on the west bank and Chaddesden on the east bank. As it progresses through Derby city centre, the R. Derwent veers to the east and the valley broadens as it approaches its confluence with the R. Trent. To the south of the city, the land is generally flat with much marshy land lining the banks of the R. Trent and the adjacent Trent and Mersey Canal. The wards of Alvaston, Boulton and Sinfin are particularly notable for this land feature and are known to have high groundwater levels throughout.

The following illustration shows the city extents and ward boundaries.

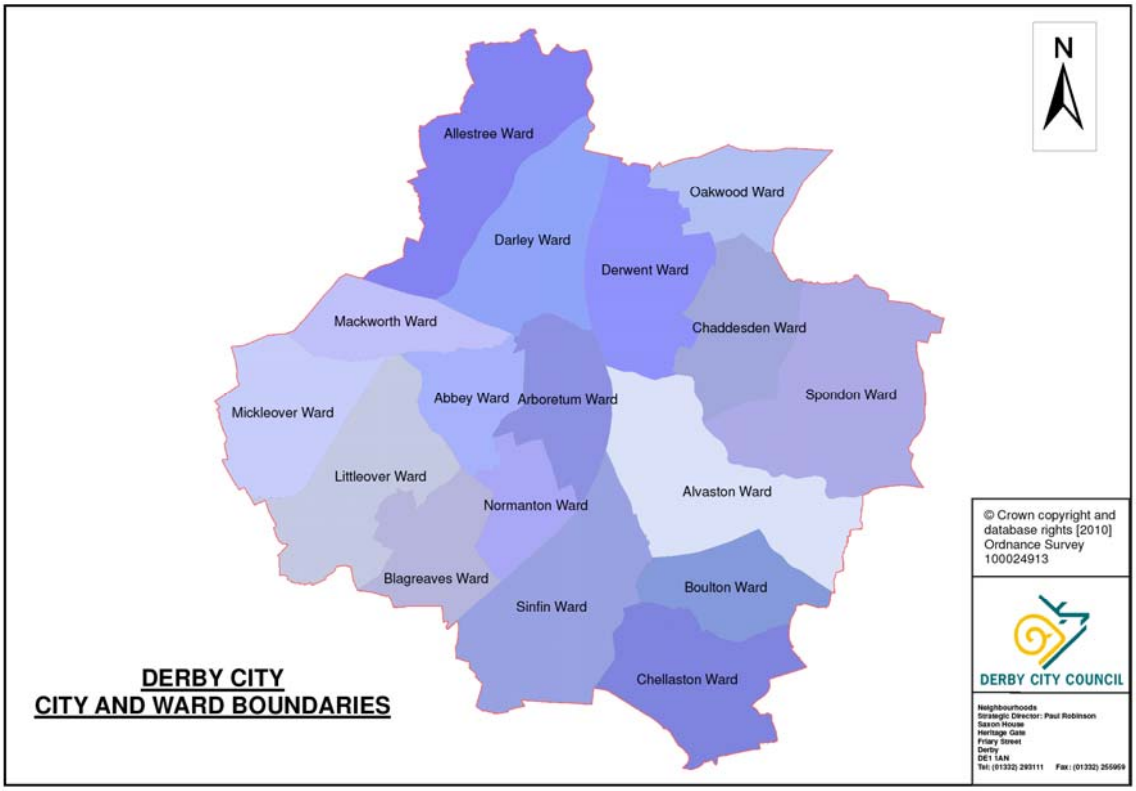

Figure 1.1 – Derby City Extents and Ward Boundaries

1.5 Watercourses

There are a number of minor and ordinary watercourses which feed through the city in a mixture of open and culverted sections, some of which have been either wholly or partially enmained by the Environment Agency, and some have been adopted by Severn Trent Water (STW) as a result of historic connections. The following is a list of the major watercourses within the Derby area, for which DCC is wholly or partly responsible. The descriptions have been extracted from the DCC level 1 Strategic Flood Risk Assessment (SFRA)[4].

1.5.1. **Markeaton Brook** – The largest of the Derby brook courses, it has a total catchment of approximately 50km^2 and is considered to be main river for much of its length. Following the 1931/32 event which resulted in extensive flooding of the city centre from the brook, the Northern Relief Culvert was constructed in 1937. This diverts peak flows from the north of the city directly to the R. Derwent, thus reducing flood risk down the brook corridor. The brook itself discharges to the R. Derwent towards the centre of the city. (Partially Enmained Watercourse).

1.5.2. **Bramble Brook** – This is a small brook course, which rises in Mickleover, to the west of the A38, and flows east towards the city, ultimately discharging into the Markeaton Brook. The head of the system has been extensively developed and primarily conveys surface water from the estate as an open watercourse. Where it enters a culvert, around 50% of flows are diverted into a 1200mm dia. STW sewer, the remainder flowing through the city, almost entirely in culvert, taking a series of surface water inflows with some additional Combined Sewer Overflows. The main Bramble Brook culvert is very old in places and major works may be required to prevent collapse. (Ordinary Watercourse).

1.5.3. **Littleover Brook** – This is a small brook which rises in the west of Littleover, not far from the head of the Bramble Brook. The flow into this brook is entirely urbanised and takes in the City Hospital and nearby A38 junction. There are notable areas along the brook which are subject to flooding and improvements are planned. This eventually joins the Bramble Brook upstream of its confluence with the Markeaton Brook. (Ordinary Watercourse).

1.5.4. **Hell Brook** – This rises in the southern part of Mickleover with the upper stretches fed by residential development and the surface water sewer network. The catchment slopes to the southeast. At its lower aspect the brook flows south across Stenson Fields and out of DCC jurisdiction, here the land is generally flat and groundwater is very high. Much flooding occurs from both waterlogged ground and overtopping of the shallow banks. The brook is partly enmained and flows ultimately into the R. Trent. (Partially Enmained Watercourse).

1.5.5. **Cuttle Brook** – This rises in the Pastures Hill/Littleover area flows generally southeast before discharging to the R. Trent near Swarkestone. It is culverted at the extreme upper and lower ends and for most of its length it is classed as main river. Prior to its exit from DCC jurisdiction, the brook passes through Sinfin Moor where the flat open topography results in high groundwater levels and the potential for flooding. (Partially Enmained Watercourse).

1.5.6. **Thulston Brook** – This rises in the Shelton Lock area and discharges into the R. Derwent. It is open brook for its entire length, forms the southern boundary of the city in the Boulton Moor area, and receives flow from both agricultural land/field drainage and surface water drainage systems. (Partially Enmained Watercourse).

1.5.7. **Cotton Brook** – This rises in the centre of Normanton and discharges to the R. Derwent to the south of the main city centre. Due to the heavy urbanisation of the city, it is culverted for almost its entire length. If the culvert collapses, it may result in flooding of some extremely disadvantaged areas of the city. (Enmained Watercourse).

1.5.8. **Lees Brook** – This rises in Locko Park to the east of the city and flows through an essentially rural catchment until it meets the Wood Brook on the extreme eastern edge of Chaddesden, and becomes known as the Chaddesden Brook. (Ordinary Watercourse)

1.5.9. **Wood Brook** – Rising in Oakwood, this collects the surface water runoff from a highly urbanised catchment before meeting the Lees Brook at the Lees Brook Community College. (Ordinary Watercourse)

1.5.10. **Chaddesden Brook** – Being the combination of the Lees and Wood Brooks this flows south to the R. Derwent, partly as open watercourse and partly as culvert, it is, however, wholly main river. (Enmained Watercourse).

Further details of the respective catchments and watercourses described above, please refer to Derby City Council's Level 1 SFRA.

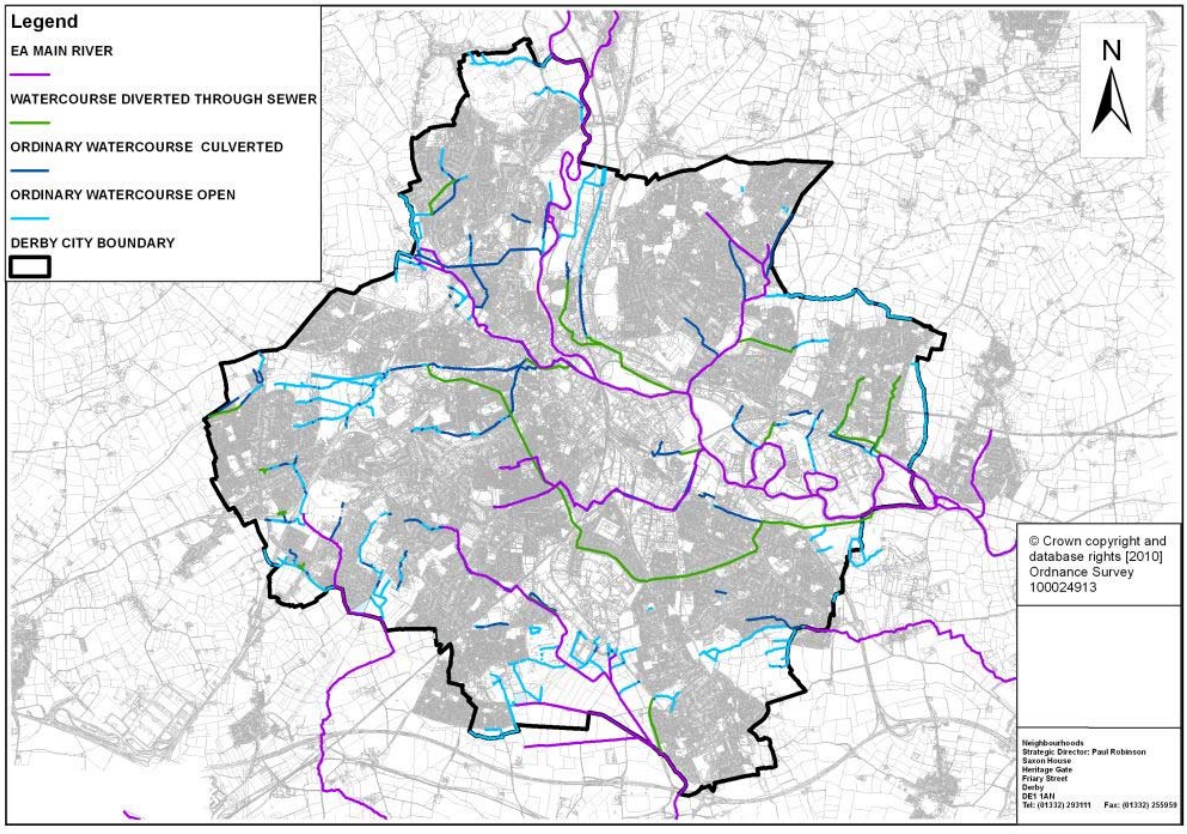

Figure 1.2 – Watercourse Map showing Derby City Extents

2 Lead Local Flood Authority Responsibilities

In terms of the Flood Risk Regulations 2009, and the Floods and Water Management Act 2010, each Lead Local Flood Authority (LLFA) is charged with the responsibility of preparing and updating a number of flood monitoring activities aimed at identifying and reducing the risks associated with flooding.

Table 2.1 LLFA Responsibilities

	Activity	Date Due	Specific Considerations
1.	Preliminary Flood Risk Assessment	22/06/2011	Consider the following sources of flooding:- Surface Water, Groundwater, Ordinary Watercourses, artificial watercourses (Canals etc)
2.	Identify Flood Risk Areas	22/06/2011	Identify areas of significant risk in accordance with the national criteria set by the UK Secretary of State.
3.	Prepare Flood Hazard and Flood Risk Maps for identified flood risk areas	22/06/2013	To show the extent, depth, direction speed of flow and probability of floods, together with potential consequences.
4.	Prepare Flood Risk Management Plans	22/06/2015	To set objectives for managing flooding and guidance for the implementation of management systems

These are, of course, merely the initial review dates for these activities, it is intended that the process should be both cyclic and ongoing in order to show an evolving awareness of flooding, and the risks associated.

2.1 Governance and Partnerships

Derby is a highly urbanised Unitary Authority in the north-east Midlands. It is wholly surrounded by the County of Derbyshire and lies within the Severn Trent Water catchment, but does not share ownership of its watercourses with any local Internal Drainage Boards (IDBs). It is bounded by Amber Valley, Erewash and South Derbyshire District councils and many of the watercourses entering the area are affected by, or affect, the surrounding authorities. The partnerships entered into as part of this review include:-

(i) The Environment Agency
(ii) Severn Trent Water
(iii) Derby City Council Planning Department
(iv) Derbyshire County Council
(v) Derbyshire Strategic Flood Board – this incorporates representatives of all district authorities within the county, the county flood managers and representatives of DCC and meets on a regular (if infrequent) basis to communicate outstanding flood issues and existing emergency planning responses. Of particular importance is the interaction with representatives from the immediately surrounding boroughs of Amber Valley, Erewash and South Derbyshire District.

2.2 Communication with public

Consultation to date has been primarily in the form of regional "Flood Fairs" (instigated as part of National Indicator 189), aimed at raising awareness of the risks associated with flooding in certain more vulnerable parts of the city. As a by-product of these meetings, we are now receiving an increasing number of enquiries and communications from members of the public in these areas.

2.3 Further responsibilities

In addition to the formation of discussion and working groups to coordinate and lead on local flood management, there are a number of further responsibilities arising from the passing of the Flood and Water Management Act 2010, these include:-

- **Investigating flood events** – LLFAs have a duty to investigate and record details of significant flood events within their area. DCC has been recording reported flooding events for some years, however the information has been somewhat limited in detail. This recording is being improved to comply with the Inspire Regulations 2009[(5)]
- **Asset Register** – LLFAs have a duty to maintain a register of structures or features which are considered to have an effect on flood risk, including details of ownership and condition. DCC has been building such a register for some time; however the work will be ongoing as our understanding of the flood risk is increased. The information is currently contained on a set of GIS shape files.
- **Sustainable Urban Drainage System (SuDS) Approving Body** – LLFAs have been designated as (SuDS) Approving Bodies (SABs) for new developments and drainage systems and will be responsible for approving, adopting and maintaining new systems. DCC has been promoting the use of SuDS for some time and has adopted some SuDS features within public open space for multi-ownership systems.
- **Local Strategy for Flood Risk Management** – LLFAs are required to develop, maintain, apply and monitor a local strategy for flood risk management in their areas.
- **Works Powers** – LLFAs have powers to undertake works to manage flood risk from surface runoff and groundwater, consistent with the local flood risk management strategy for the area.
- **Designation Powers** – LLFAs, district councils and the EA have powers to designate structures and features that affect flooding or coastal erosion in order to safeguard assets that are relied upon for flood or coastal risk management.

3 Methodology and Data Review

3.1 Information gathered

The purpose of this PFRA has been to determine the extents and severity of past flooding events, and estimate the potential for future flooding. In order to achieve this it has been necessary to collate a large amount of information, from a number of sources. This information has been used to reconstruct the events discussed in section 4. The following table details the sources approached for records and data in support of these events.

Table 3.1 Sources of Information for Flooding

Organisation	Nature of data	Description
Environment Agency	Flood Maps	Localised section of the nationwide flood maps available for the determination of flood zones.
	Historic Flood Maps	Shows the recorded extents of all officially reported events arising from rivers, springs and coastal areas, together with indications of past flooding.
	Areas Susceptible to Surface Water Flooding (AStSWF)	Modelled flood data for distinct events, based on LIDAR generated contours and predicted rainfall events. Assumes zero entry to sewer network.
	Flood Maps for Surface Water (FMfSW)	Modelled data, also based on LIDAR information, but having better detail.
	Areas Susceptible to Groundwater Flooding	GIS layer categorising each 1km OS grid square into 4 groundwater flood risk categories
	National Receptor Property Dataset	A national collection of property point data.
	National Receptor Dataset (NRD)	GIS data of social, cultural and environmental information containing: Battlefields; Listed Buildings; National Parks and National Trails
Severn Trent Water	Sewer Network Data	A GIS map of the local sewer network.
	Sewer Flooding Register	Records of flooding from sewers
Derby City Council	Historical Flooding Records	Collected records of past flooding around the city showing where problems have been reported.
	Knowledge of Local Watercourse network	Continued maintenance of a number of grills and headwalls has resulted in detailed knowledge of the local watercourses for Derby.
	DCC Listed Building Register	Statutory List – Derby City Buildings of special Architectural or Historical Interest
Derbyshire County Council	Wider Area Records	Membership of the Derbyshire Strategic Flood group has allowed access to contacts from surrounding authorities.
Public Domain	Media Search	Historic records of past flood events
Emergency Services	Records of attendance at Flooding occurrences	Little information has been received to date in response to our enquiries.

Other data sets referred to but not used include:-

Organisation	Nature of data
EA	Detailed River Network
	Flood Defences
	Flood Storage Areas
	Areas Benefiting From Flood Defences
	Historic Landfill Areas

For the purposes of collating and illustrating information on the following plans reference has been made to the Environment Agency (2010) Flood Map for Surface Water Property Count Method[6].

3.2 Availability and limitations

Each of the above sources yielded a variety of information and was subject to specific limitations. These are stated below:-

- **EA - Flood Maps** - Historically these have been generated from a series of large scale flood models and are often inaccurate when considered at the local level. With time, these maps are being refined, and more detailed flood information is available for some areas.

- **EA – Historic Flood Maps** – The level of accuracy and detail available is limited by the information requested and provided at the time of the event. Subject to a specific licence agreement.

- **EA - Areas Susceptible to Surface Water Flooding (AStSWF)** – This is one of two datasets based on the increased availability and accuracy of Light Detection and Ranging (LIDAR) and GeoPerspective information provided as a by product of sweeping aerial photography across the country. The information is based on a single summer storm event of 1 in 200 year (0.5%) recurrence probability and 6.5 hours duration. It makes no allowance for sewers or the presence of buildings, does not consider infiltration from surface water flooding and measures the modelled flows in three risk bands, “less”, “intermediate” and “more”. Subject to a specific licence agreement.

- **EA – Flood Maps for Surface Water (FMfSW)** – This second dataset also uses LIDAR data, but with added Ordnance Survey (OS) Mastermap layouts and raised building imprints to allow for flow routing. Surface water flooding is based on two storm events, the 0.5% recurrence identified above plus a 1 in 30 year (3.33%) recurrence event, storm durations are reduced to 1.1 hours giving higher storm intensities. Infiltration is included, there being two rates of flow reduction for urban (30%) and rural (61%) areas respectively. In addition the dataset also includes for the effects of sewers. There are two threshold depth bands, greater than 0.1m and greater than 0.3m. Subject to a specific licence agreement.

- **EA - National Receptor Dataset** - The quality and detail of the data available is limited by the survey and valuation information provided. Subject to a specific licence agreement.

- **STW - Sewer Network Data** - Based on known nodes and pipes input by Severn Trent operators. Occasionally the nodes are misplaced, or the complete information is not available, particularly if the system is very old or manhole covers cannot be lifted. Condition and status are not always available therefore it can be difficult to determine the available capacity of the system. STW, and their consultants, are currently undertaking a detailed review of the network data in order to develop a better understanding of the system, however this may take some time to complete. Subject to a specific licence agreement.

- **STW – Sewer Flooding Register** - This database is subject to a licence agreement from Severn Trent restricting the use of the data for the PFRA only. The Data has been down graded so that individual properties are not identified. Subject to a specific licence agreement.

- **DCC - Historical Flooding Records** - Much of the information has come from members of the public or from highways inspectors. Where the information is supplied by the general public, the reports may be subjective or missing critical information – such as extents, depths or point of origin.

- **DCC - Local Watercourse Network** - Knowledge of the local network allows the vulnerable points to be identified, but dealing with the “at risk” sections is also tempered by local knowledge.

- **DCC - Listed Building Register** – This gives an index of the impact on heritage when flooding occurs.

- **Media Search** - On-line heritage and history magazines or websites are a good place to locate notable occurrences and reports of past events. Notable floods like those which occurred in 1931/32, 1965 or 2007 will have produced strong memories in those affected. Such information can be invaluable in determining the physical extents of flooding when the visual evidence has long disappeared. The drawbacks are that memories fade over time and the authors may no longer be traceable.

- **Emergency services** - Contacts have been made with relevant services, however little information has been made available to date.

3.3 Sharing and storing of information

Information related to flooding within Derby has been collected over many years and has traditionally been stored in paper format. These records have been related to specific watercourses, where applicable, or assigned to a general flooding file where not. Historically, reports and problems have been dealt with on a site-by-site basis. More recently, however, the reports have been added to our arcGIS system, and have been imported onto spreadsheets for further evaluation and dissemination.

For future events, records are to be entered directly onto a suitable, centrally maintained, and accessible, spreadsheet. The layout and /or data entry forms or mechanisms will be set out to maximise the collection of data with a minimum of technical knowledge.

Information gathered is stored within our secure server, and is recorded as a defined GIS shape file layer.

Where information has been supplied by external sources, and particularly in the case of the EA and Severn Trent Water, confidentiality agreements have been signed to protect the relevant sources as required. DCC have collaborated in the Derbyshire County Council Sharepoint system for data sharing with partners.

3.4 The Significance of Flooding Data

The nationally defined Flood Risk Areas have been defined as set out in Annex D of the DEFRA document "Selecting and reviewing Flood Risk Areas for local sources of flooding". In this, a series of 1km grid squares were set up to cover sites where a minimum of 200 people, 20 commercial properties or 1 critical service might be affected by flooding to a depth of 0.3m with a potential recurrence of 1 in 200 in a given year (0.5%). Where these were found to group into more densely concentrated areas they were then combined into larger 3km grid squares centred over clusters of squares. This then was the method of determining large national grid clusters with minimum population sizes of 30,000, defined as Indicative National Flood Risk Areas.

The above definition, set out by DEFRA, allows the determination of national flood risk areas, however there is currently no official guidance on the preparation of Locally Significant Areas of Significant Harmful Consequence. Advice from the Environment Agency suggests that the threshold for Locally Significant Harmful Consequences should be set one order of magnitude below that of the national definition. Additionally it should involve an explicit number of properties.

Thus the Locally Significant Thresholds may be determined to be equivalent to 5 residential properties, 2 commercial properties, one or more items of critical infrastructure, or a transport link being totally impassable for a significant period.

The determination of "significant period" for infrastructure is related to the grade of the infrastructure concerned and is as set out in table 1 of the UK Roads Liaison Group (UKRLG) Code of Practice for Highway Maintenance.

3.5 Setting of Local Significance Thresholds

In practice, the nationally derived grid squares and clusters are too large to be of use in identifying local flood risk areas and it is necessary to adopt a much more detailed system of analysis. On this basis, a more limited local threshold limit has been adopted by most other local authorities, Derby is no exception.

Once the flood corridors associated with the Rivers Derwent and Trent are removed, together with the other main river sections of the various brook courses, Derby currently suffers very little fluvial flooding with the exception of a few hotspots. On this basis we have downgraded the locally significant criteria, based on historical data, to a more realistic level. Table 3.2 shows the current evaluation of the circumstances that are deemed to trigger a significant local event in Derby.

Table 3.2 – Local Significant Harmful Consequences

Consequence	Damage	Impact
Health Risk	Harm to people	10+ Persons
	Damage to properties	5+ Residential properties
	Risk to Life	1+ Person
	Interruption of critical service	1+ Item of critical service
Economic Risk	Business	2+ Business
	Non-residential properties	4+ Properties
	Residential properties	4+ Properties
	Garden flooding	10+ Gardens
Infrastructure Risk	Category 1 highways (motorways) and major rail links	2 Hours or more
	Category 2 (trunk roads) and 3a (main distributor) and normal rail links	4 Hours or more
	Category 3b (secondary distributor) and 4a (link road)	10 Hours or more
	Category 4b (local access)	24 Hours or more

Note

I. The calculation for impacts on residential properties and residents is roughly based upon the multiplier of 2.34 people/property (rounded up).
II. Critical services are taken to include hospitals, fire/ambulance/police stations, power stations, electrical sub-stations and schools amongst others.
III. Infrastructure hierarchy is based upon table 1 of the UKRLG Code of Practice for Highway Maintenance.

4 Past Flood Risk

Derby has a long history of flooding, with records dating back to the early 1600s. Most of the recorded events describe major flooding from the R. Derwent or Markeaton Brook, and include the inundation of residential development, critical highway infrastructure and the occasional loss of life.
Sources of flooding experienced include primarily Fluvial and Pluvial, Derby no longer has a functional canal and there is little historical evidence of groundwater flooding.
The following examples are included to illustrate a selection of the most extreme or notable events, all of which are considered to be of local harmful significance.

When considering the significance of a flood event, we must first set boundary conditions against which an event may be measured. The DEFRA guidance document "Selecting and reviewing Flood Risk Areas for local sources of flooding (2009)"[7] sets out the conditions and parameters for determining the nationally recognised areas of significant risk or "Flood Risk Areas" in accordance with the "Flood Risk Regulations 2009".

4.1 Record of Past Flood Events of Local Significance

1931 & 32 – Despite previous attempts to improve the overall infrastructure and resilience to flooding, the city was subject to two successive annual flood events. The first, in 1931, arose from the R. Derwent, while the second, a year later emanated from the Markeaton Brook, both were fluvial in nature. During the 1932 event a 250-300m wide stream flowed through the city centre, resulting in the inundation of many properties. Fluvial flooding was also reported within the Bramble and Littleover Brook catchments, both with inundation of properties. Figure 4.1 shows the combined effects of the two events. The pink shaded area is that emanating from the River Derwent, while the blue shading covers the path of flooding from the Markeaton Brook.

Following these events, the then County Borough of Derby commissioned a major study of the current drainage system and subsequently embarked on the construction of two major flood relief culverts for the Markeaton and Bramble Brooks and a thorough upgrading of the city's sewer system. These culverts, known respectively as the Northern Flood Relief Culvert (Culvert No.1) and the Bramble Brook Culvert (Culvert No.2) were commenced in 1936 and completed in the 1960s.

This type of event would now be recorded as a Significant Event, however the improvement works carried out have rendered this particular episode unlikely to reoccur.

1965 – Occurring shortly after the completion of the above culverts, fluvial flows from the R. Derwent flooded the Little Chester area of Derby with nearly 700 properties being affected. At the time this was a major event causing loss of life and major disruption to the city. However, following the completion of the works to the sewer network and the two flood culverts no major flooding of the sewer network or the Markeaton, Littleover and Bramble Brooks was recorded. Following this flood, the city's existing river defences were increased and the city has not been flooded from the river since.

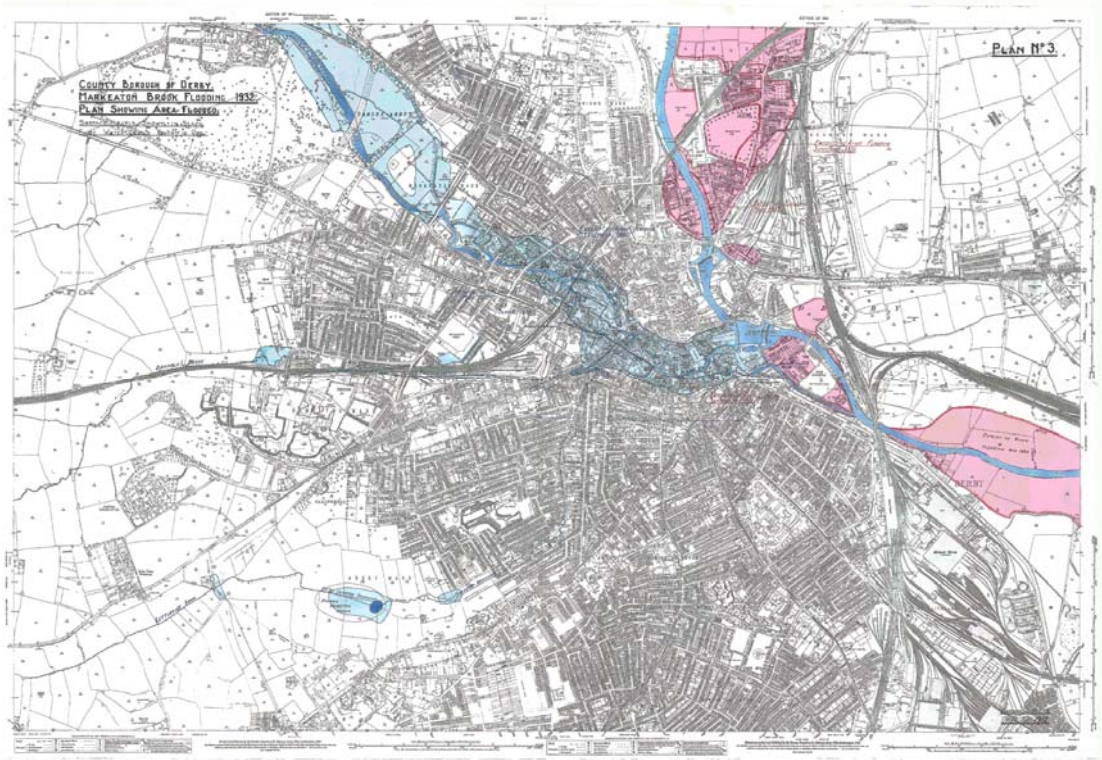

Figure 4.1 Historic Flood Events 1931/32 – Markeaton Brook

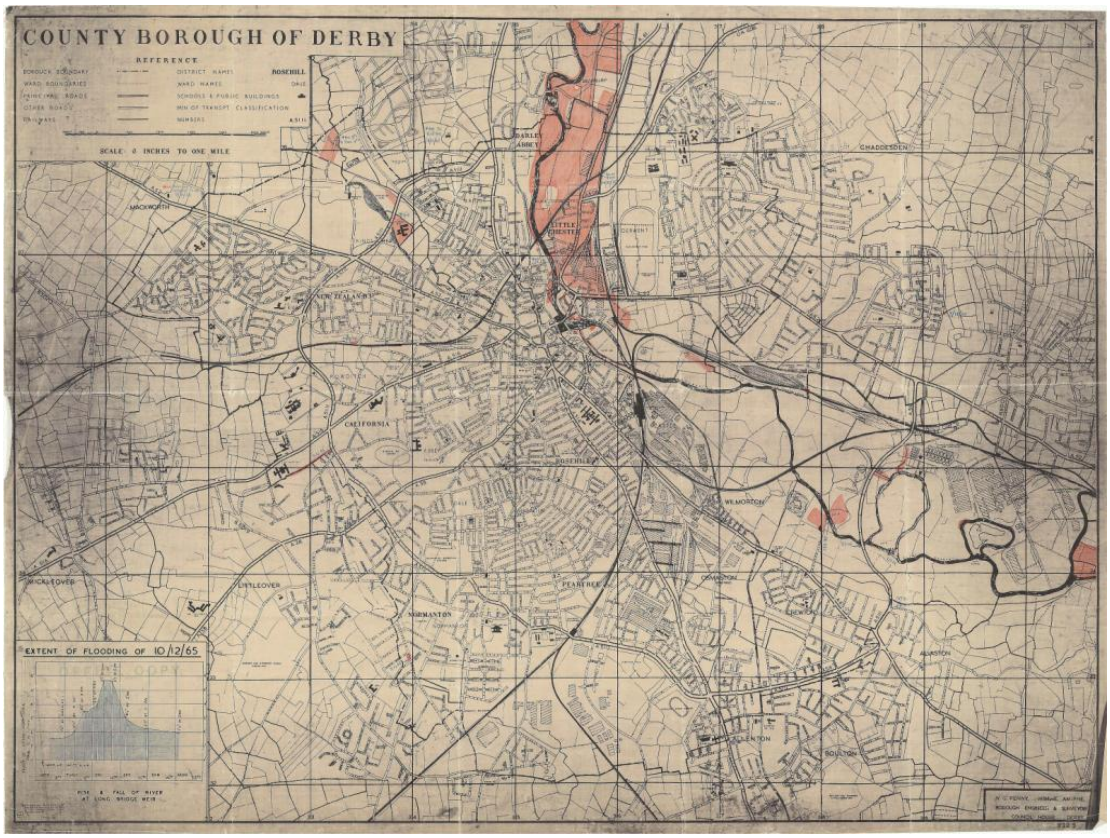

Figure 4.2 Historic Flood Events 1965 - Flooding of Little Chester from the River Derwent

9 July 1981 – A report in the Derby Evening Telegraph alludes to a tumultuous storm over the city, following a very chilly and miserable June. Temperatures rose dramatically in early July and the cool weather was replaced with hot, humid conditions resulting in a focussed and intense storm which saw approximately 80mm of rainfall in some 70-80

minutes. Gullies and drainage systems were inundated. Many properties, both residential and commercial, were flooded, phone lines were interrupted, the city hospital had to abandon operations, and roads were flooded. Emergency calls were received from all parts of the city and disruption lasted for several days. The event extended as far north as Bakewell. This was a pluvial event of locally significant proportions.

5 November 2000 – A prolonged period of wet weather culminated in an intense storm which impacted on the already swelling R. Derwent and the Markeaton and Mackworth Brooks, causing the two latter watercourses to breach their banks just north of the city boundary. The resulting flood inundated approximately 3 properties in the Markeaton Lane area, some of which strictly fall outside the city boundary and were not officially recorded. Fortunately the existing weir structures to the southeast of Markeaton Lane diverted the majority of flows along the Northern Flood Relief Culvert into the R. Derwent, although 1 further property was inundated at St. John's Terrace.
In addition to the above, the same event resulted in sewer flooding to 10 properties in Stenson Road and a further 6 properties in the Littleover Brook area.
Traffic was severely disrupted throughout the city by the closure of the Eastgate underpass on the inner ring road. This underpass was drained by pumps that were at the time situated beneath the carriageway in the bottom of the underpass. A complex drainage situation occurred where a combination of high river levels and the heavy rain lead to surcharging of the public sewers which inundated the underpass. The high flood volumes resulted in a total failure of the pumps and the control system. As a result the underpass flooded to a depth of approximately 3m. This rendered the pumps inaccessible and the Eastgate underpass remained closed for several days until temporary pumps could be installed. Although resulting from a pluvial event the flood may be considered fluvial.

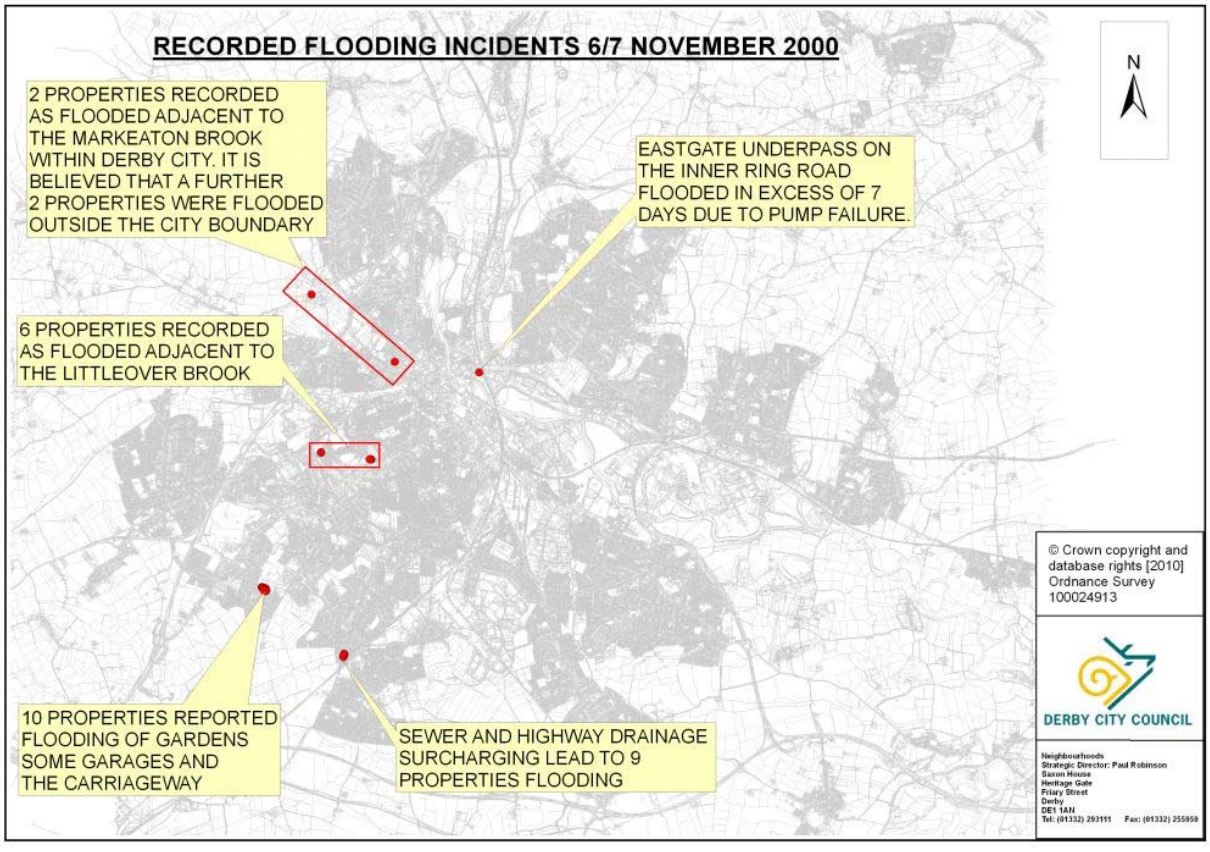

Figure 4.3 Historic Flood Events November 2000

7 July 2001 - A heavy storm struck Derby that was reported by residents to have lasted between 20 and 40 minutes.

In the Stenson Road area this storm led to both the surcharging of the highway drainage system and the sewer network. A combination of foul water from the sewers and surface water from the highway then flowed along the carriageway to the lowest point in this area of Stenson Road where the flood water crossed the footways in an easterly direction and flooded 9 properties to depth of up to 200mm.

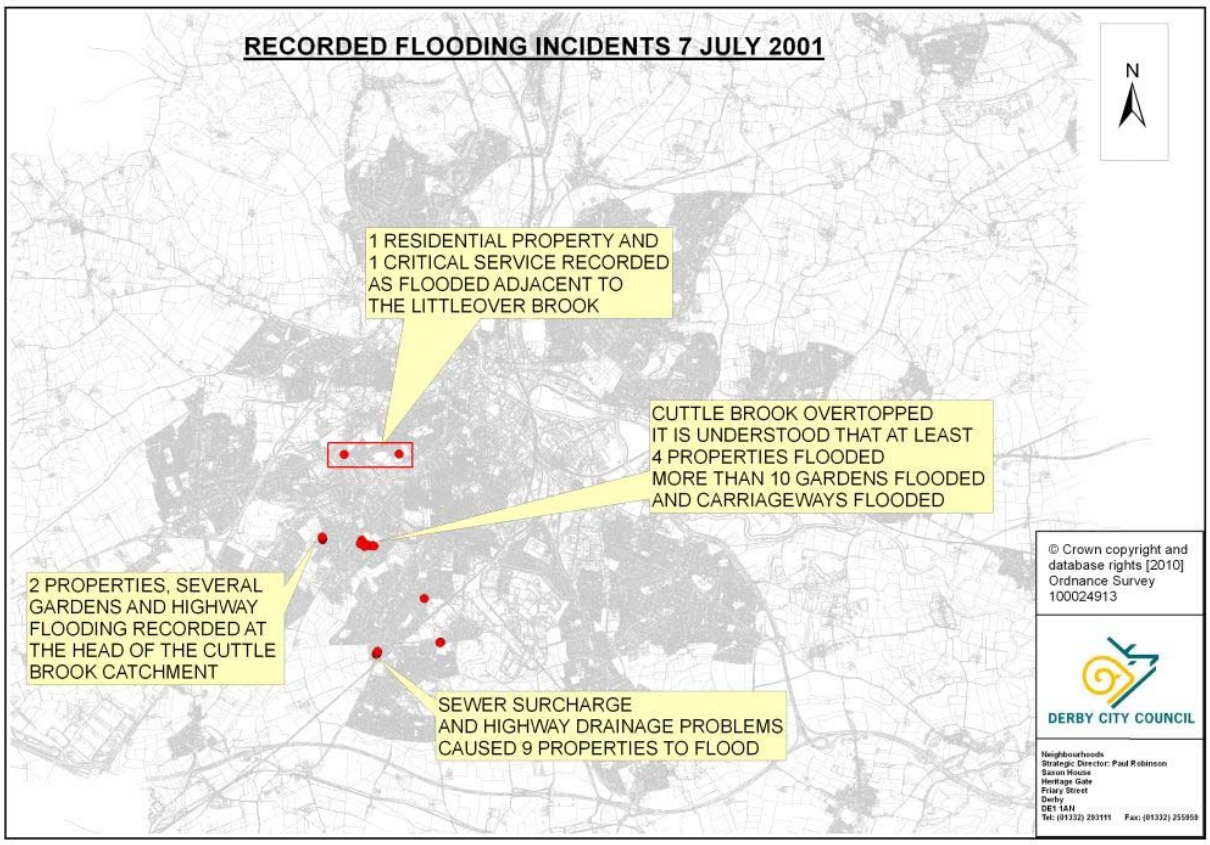

Figure 4.4 Historic Flood Events November 2001

Cuttle Brook - The storm also caused flooding in the Taverners Crescent area of Cuttle Brook. The Council received a petition from 32 residential properties stating that their properties had suffered damage. The exact extent of the damage is not evident from the records however it appears that at least 4 houses were inundated.
Intense rain falling on the upper urbanised catchment of the Cuttle Brook resulted in large volumes of water entering the culverted section of the watercourse via the public surface water sewer network. The culvert discharges into an open section watercourse which flows through back gardens for 190m parallel to Taverners Crescent before re-entering a culverted section of the brook. It appears that the restriction on capacity at this location caused the brook course to overtop inundating the properties gardens and the highway.

Littleover Brook - Bishop Lonsdale School flooded as a result of sewer surcharging depth not recorded. 1 residential property also reported internal flooding.

30 July 2002 – Following a period of heavy rain, some 40 separate flooding reports were received during the late afternoon and evening, including 10 reports of lifting manhole covers. In addition, there were a number of requests for sandbags, of which two were from the City Hospital (now the Royal Derby Hospital). A number of roads across the city

were reported flooded, of which the most notable being St. Alkmund's Way and Eastgate underpass which was closed at around 18:00 hours, for several hours following pump failure.

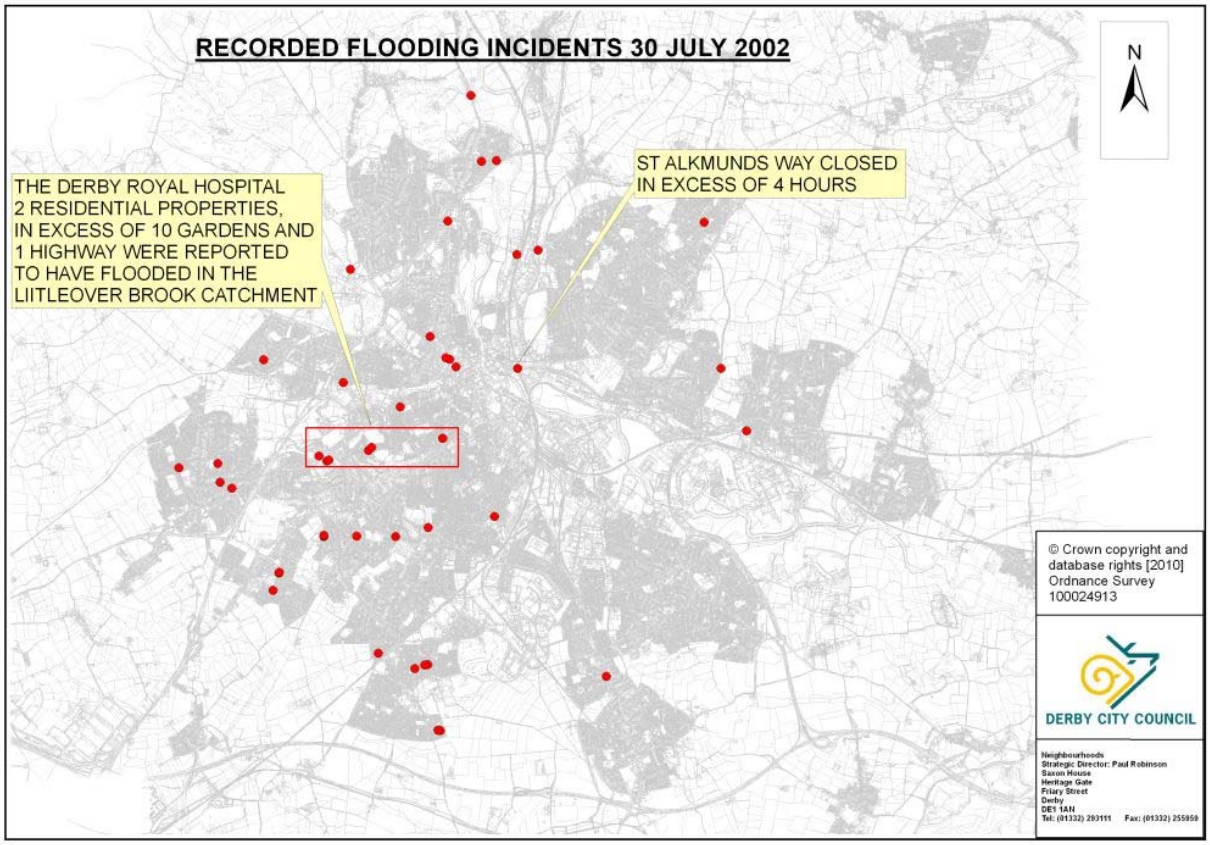

Figure 4.5 Historic Flood events July 2002

4.2 Summary of Significant Flood Events and Consequences

It is considered unlikely that, since 1965, any flooding occurrence will have achieved the level of severity that a flood of National Harmful Significance may be considered. The following table, therefore shows more recent events rated against the lesser Local Significance severity classification identified in table 3.2.

Table 4.1 Summary of Locally Significant Flood Events and Consequences

Date	Location	Local Significant Harmful Consequence	Reason
9 July 1981	Citywide	Yes	Damage of residential and commercial property, interruption of critical services, flooding of infrastructure (Cat 2)
5 November 2000	Markeaton, Littleover, Stenson Road, Eastgate Underpass	Yes	Damage of residential property, Flooding of infrastructure (Cat 3a)
7 July 2001	Stenson Road, Cuttle Brook, Littleover Brook	Yes	Damage of residential property (Cat 3a, 3b)
30 July 2002	Citywide	Yes	Flooding of infrastructure (Cat 2, 3a, 3b)

4.3 Improvement Works

The improvement works carried out between the 1930s and late 1960s have substantially reduced the risk from both pluvial and fluvial flooding. This is demonstrated by the extended period since the last major flood of 1965. However more recent floods, particularly those of 1981, have demonstrated that parts of the city are still vulnerable to surface water flooding caused by heavy short duration storms. Again steps have been taken to reduce surface water flooding. These included the following:-

1 Working in partnership with the EA and DEFRA to undertake alterations to Markeaton and Mackworth Brook weir structures to limit exceedance flood flows over the weir towards the city centre, diverting more flood flows into the Northern Flood Culvert. Completed 2007.

2 Working in partnership with Severn Trent to improve the highway drainage and sewer systems at the head of the Cuttle Brook to reduce flood risk in the Hollow area of Littleover. Completed 2006

3 Working in partnership with Severn Trent to integrate new highway drainage with major sewer works to improve both the highway and sewer network in the south east of Derby to offer flood risk reduction to this area in particular for the properties that flooded in the Stenson Rd area. Completed.

4 Replacing highway drainage in the Corden Avenue area and the introduction of balancing tanks, to reduce flood risk to this area and the Littleover/ Bramble Brook catchment in general. Completed 2010.

5 The implementation of a regime of regular brook course inspection and maintenance in 2002 to reduce flooding caused by watercourse blockages.

6 Entering into a contact with the EA to carry out a similar function on the ordinary watercourses that were enmained in 2006.

4.4 Summary Plan of Past Floods

The following plan shows all flooding incidents recorded by Derby City Council and Severn Trent Water since 1991. The 1931, 1932, 1965 and 1977 flood events have not been included because the flooding was largely caused by fluvial flooding from the River Derwent which falls outside the scope of this report or because major drainage and flood defence works have been undertaken which have a substantial improvement on the flood risk to these areas.

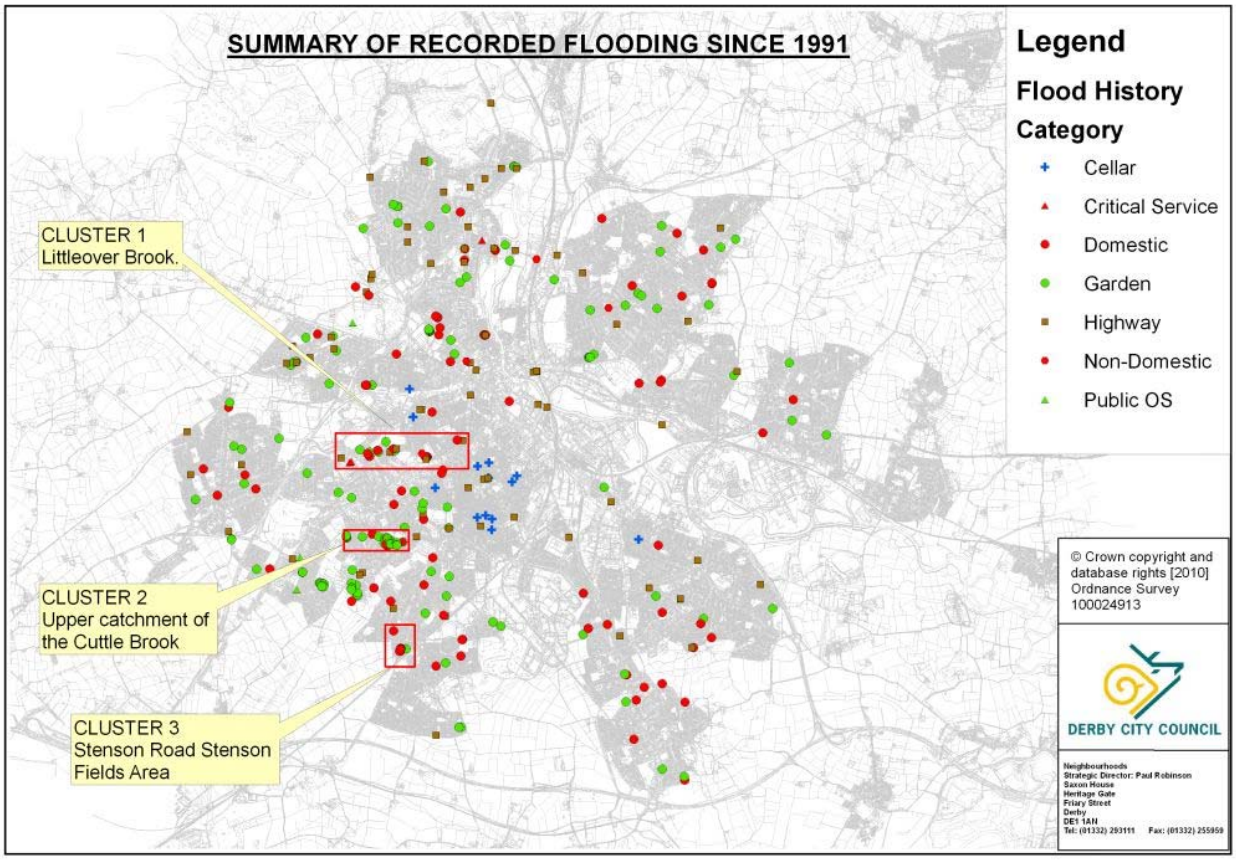

Figure 4.6 Summary of Historic Flooding

During the investigation of past flooding three recurring clusters have been identified:-

Cluster 1
Littleover Brook catchment. There is a long history of flooding along this catchment caused by a combination of development over the years on the flood plain, culverting of the brook course and the limitation on the hydraulic capacity of the watercourse.

Cluster 2
Upper catchment of the Cuttle Brook. Properties have flooded in this area on a number of occasions since 2000 in particular the 2001 event where at least 6 properties in the area reported inundation. The improvements work undertaken by STW and DCC in The Hollow area of Littleover referred to in section 4.3 will have reduced flood risk but may

not offer protection to the 1% standard. The area has therefore been included for further study.

Cluster 3

9 Properties in the area had experienced flooding over a number of years culminating in being flooded in consecutive years 2000 and 2001 due to lack of sewer capacity and highway drainage issues. The major sewer improvement scheme referred to in section 4.4 will have offered flood risk reduction to a probability of at least 3.3% however as this is less than the 1% standard the area has been included for further study.

5 Future Flood Risk

The PFRA also includes an assessment for future flooding, to be defined as “any flood that could potentially happen in the future”. This may seem a little extreme, however the criteria for future flooding may be conservatively considered to be at least as severe as those occurring in the past, but making an additional allowance for the effects of climate change. The preferred method for assessing future flooding is to use an assessment of the DEFRA flood mapping information.

Surface Water Flood Datasets - As defined in section 3 above, the EA has prepared two datasets relating to surface water flooding, both are based on low resolution LIDAR data with a vertical accuracy of approximately of +/- 150mm.

The first dataset (AStSWF) is based on a single 6.5 hour storm event of 1 in 200 (0.5%) probability and has been collated into separate risk bands “Less”, “Intermediate” and “More”, no allowance for sewer networks has been made.

The second dataset (FMfSW) looks at two 1.1 hour storm events with 1 in 30 (3.33%) and 1 in 200 (0.5%) probability respectively. This dataset also makes an allowance for the average capacity of urban sewer systems by reducing the rainfall intensity by 13mm per hour. The flooding zones for these storms were each divided into two depth zones of 0.1m (shallow) and 0.3m (deep) giving far greater flexibility for estimating flood risk.

For the purposes of developing an initial estimate for future flood risk, the FMfSW dataset has been adopted for the determination of initial risk figures. The shorter more intense storm is more typical of the storm profiles that cause surface water flooding in an urban environment, plus this dataset is more realistic in that it makes an allowance for the capacity of the urban sewer network. The 1 in 200 storm was used as it is this storm that would produce a flood envelope similar to a 1 in 100 year flood envelope. The 0.3m deep flood envelope has been used to assess property damage as it is believed that 0.1m flood depth is unlikely to be deep enough to cross property thresholds and cause internal damage.

For this reason the FMfSW 1 in 200 year 0.3m deep flood envelope is the dataset will be used to assess future flood risk.

Flood Receptor Dataset - Consideration was given to using Derby City’s Local Land and Property Gazetteer. This dataset provided a more accurate property classification than the NRD, however it was not very well geospatially referenced making it unsuitable for use for flood risk analysis.
Derby City Listed Building Register Dataset also provided a more accurate assessment than the listed buildings data within the NRD and was used to give an indication of the risk to Heritage properties.

For this reason the NRD has been used for the general assessment of future flooding in Derby with the exception of the Listed Buildings where Derby City Listed Building Register has been used.

5.1 Description of Anticipated Sources and Consequences of Future Flooding

5.1.1. **Surface Water Flooding** – Derby City Council is in the process of preparing its own Surface Water Management Plan (SWMP) although, to date, it has not yet carried out detailed flood modelling. It does, however, have a completed Level 1 SFRA, based on catchment studies, LIDAR data and condition surveys of local watercourses.

As stated in section 3.6 (and by definition section 3.2) above, the future determination of flood risk from surface water has been largely based on two datasets provided by the EA. The second dataset, entitled "Flood Map for Surface Water", (FMfSW) is generally considered to have far greater relevance in determining the depths and extents of Surface Water Flooding, although it should be stated that this is still based upon LIDAR data and certain local variations are inevitable.
Another benefit in the adoption of the FMfSW dataset is the EA's preliminary estimation of properties at risk based on the flooding data. The following figures have been adopted for use in the accompanying spreadsheet.

Table 5.1 - Estimate of Properties at Risk of Surface Water Flooding

Indicators	Depth (m)		0.3
Human Health	All Properties		7300
	Residential		5800
	People at Risk		13600
	Critical Services		106
Heritage	Listed Buildings		77
Economic	NRD Classification	UKRLG Category	Length Flooded (m)
	A Road	2	5466
	B Road	3a/3b	43
	Minor Road	4a	6405
	Local Street	4b	19114
	Pedestrianised Streets	4b	526
	Private Road	4b	1544
	Rail General		673
Environmental	Active IPPC		1
	Active RAS Authorities		3
	Active RAS Registrations		1
	Waste Licences REGIS		10

5.1.2. **Sewer Flooding** – STW are currently updating their existing Sewer Management Plan (SMP) of Derby, with the aid of their current framework consultants. DCC are engaged with STW in a partnership over this process and an updated model is expected towards the end of 2011.
The anticipated increases in flash storm occurrences will ultimately result in greater point inflows to the sewer network. This will tend to increase the short-term loading on sewer systems, and may lead to increased surface runoff. The topography of the city will result in increased flows towards the existing brook courses and, since many of these have been culverted, will result in flooding in low spots.

5.1.3. **Ordinary Watercourses** – As indicated in section 1.5, Derby has a number of watercourses, many of which have been culverted as they pass through the city. Some are under local (DCC) control and some have been enmained by the EA. Those that are defined as Enmained Watercourses are:-
Markeaton Brook;
Chaddesden Brook;
Hell Brook;
Cotton Brook
Cuttle Brook and
Thulston Brook

Some of these are currently being assessed by the EA with the assistance of an outside consultant, DCC have been involved with the studies and will be appraised of the results. Of the remaining watercourses, the Littleover and Bramble Brooks are of special concern, both having particular potential for flooding due to the overall capacity and condition of the open and culverted channel sections. These are under review with DEFRA funding, and DCC are currently considering options for improvements. Bramble Brook is included, not for itself, as such, but for its interaction with the Littleover and Markeaton Brooks, and the public sewer network via its overflow interface with the Central Interceptor Sewer (also known as Culvert No.2). This has the potential to exacerbate flooding off catchment.

Other works being, or recently having been, carried out on local watercourses include:-

- Regular inspections and maintenance of all major internally managed watercourses.
- All culvert inlets fitted with screens which are regularly cleaned and maintained to minimise the build up of debris and maintain flows.
- DCC are involved in an EA funded maintenance contract for care of all Enmained Watercourse within its jurisdiction.
- Cleaning and minor widening of the Littleover Brook.
- The installation of balancing tanks and the replacement of inadequate highway drainage in the Corden Avenue area which is in the upper catchment of the Littleover Brook.
- STW works to construct a major new sewer outfall to provide protection to S.E. Derby.
- Working in partnership with Severn Trent to upgrade the sewer network and installation of new highway drainage at The Hollow, Littleover (Cuttle Brook)

5.1.4. **Groundwater** – DCC has no specific records that detail problems associated with ground water flooding, other than reports of cellar flooding which can be caused by high ground water levels. To assess the susceptibility to ground water flooding the Areas Susceptible to Ground Water Flooding (AStGWF) dataset supplied by the Environment Agency has been used.
The following is an extract from the Guidance Note supplied with the data and describes how it was derived:-

> "*This data has used the top two susceptibility bands of the British Geological Society (BGS) 1:50,000 Groundwater Flood Susceptibility Map and thus covers consolidated aquifers (chalk, sandstone etc., termed 'clearwater' in the data attributes) and superficial deposits. It does not take account of the chance of flooding from groundwater rebound. It shows the proportion of each 1km grid square where geological and hydrogeological conditions show that groundwater*

might emerge. The susceptible areas are represented by one of four area categories (listed below) showing the proportion of each 1km square that is susceptible to groundwater emergence. It does not show the likelihood of groundwater flooding occurring.

In common with the majority of datasets showing areas which may experience groundwater emergence, this dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The data should not be interpreted as identifying areas where groundwater is actually likely to flow or pond, thus causing flooding, but may be of use to LLFAs in identifying where, for example, further studies may be useful. For example, under the Flood Risk Regulations, LLFAs will need to produce Flood Hazard and Risk Maps and Flood Risk Management Plans where there is a substantial risk from groundwater flooding within a Flood Risk Area.

.

Data Attributes

The data has the following attributes:-

1	*FLOODTYPE*	*Flood susceptibility type:* *Clearwater;* *Clearwater and Superficial Deposits Flooding; or* *Superficial Deposits Flooding.*
2	*CLASS*	*Area classification (proportion of each 1 km square that is susceptible to groundwater flood emergence):* *< 25%;* *>= 25% <50%* *>= 50% <75%* *>= 75%.*

Absence of values for any grid square means that no part of that grid is identified as being susceptible to ground water flooding."

The above AStGWF dataset has been plotted together with the location of cellar flooding.

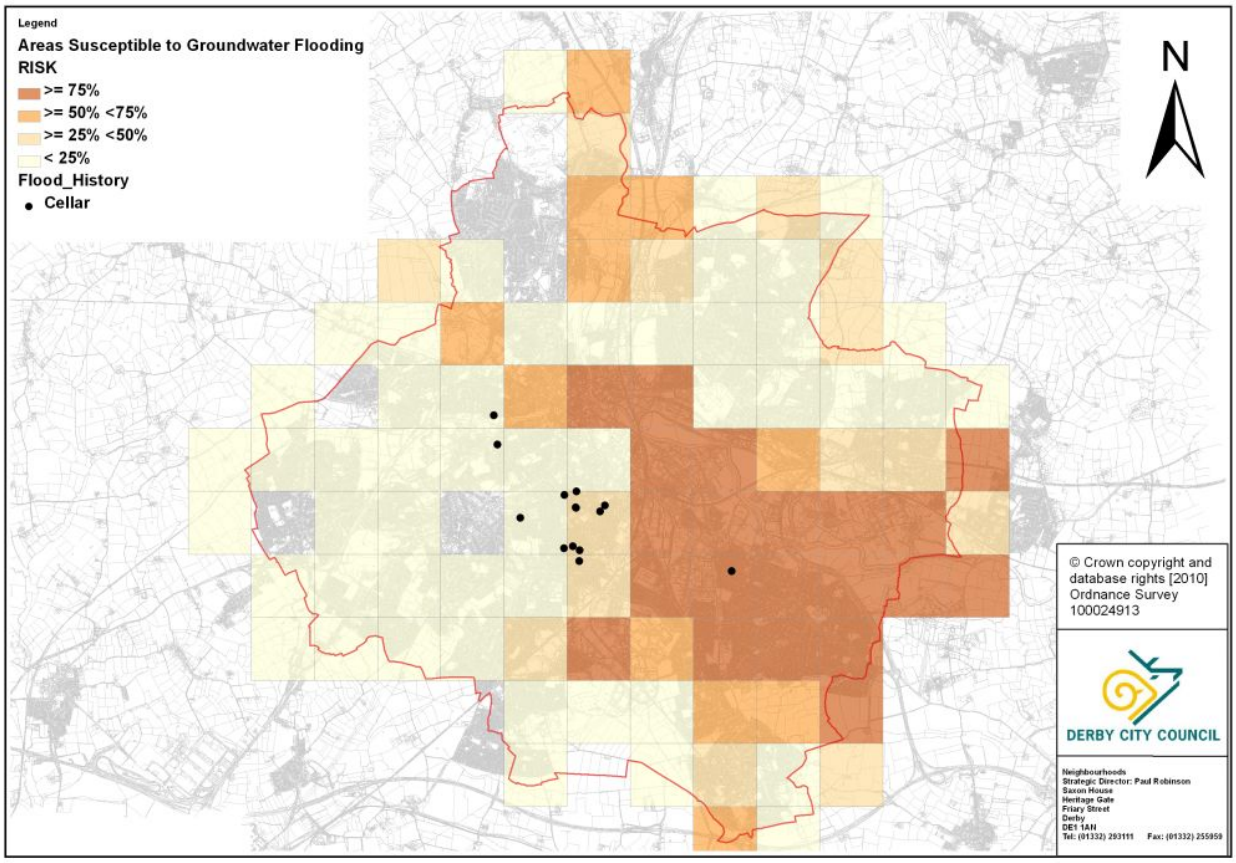

Figure 5.1 Plan of Areas Susceptible to Groundwater Flooding

5.1.5. **Future Development** – If allowed to proceed unrestricted, it is probable that continuing development in urban areas will continue to impact on existing drainage systems and capacities, and the prices placed upon land will drive development into ever higher densities.

Planning Policy Statement 25 (PPS25) was introduced in December 2006 and, in addition to guiding new development away from land inappropriate for its style of usage, aims to encourage developers and local authorities to quantify and accept responsibility for the consequences of their development and the volumes of storm runoff generated. Treating, holding and using water at the point of generation is recommended.

5.2 Summary Plan of Future Flooding

The following plan is an indication of those areas of Derby which are projected to lie above the nationally generated Flood Risk Threshold.

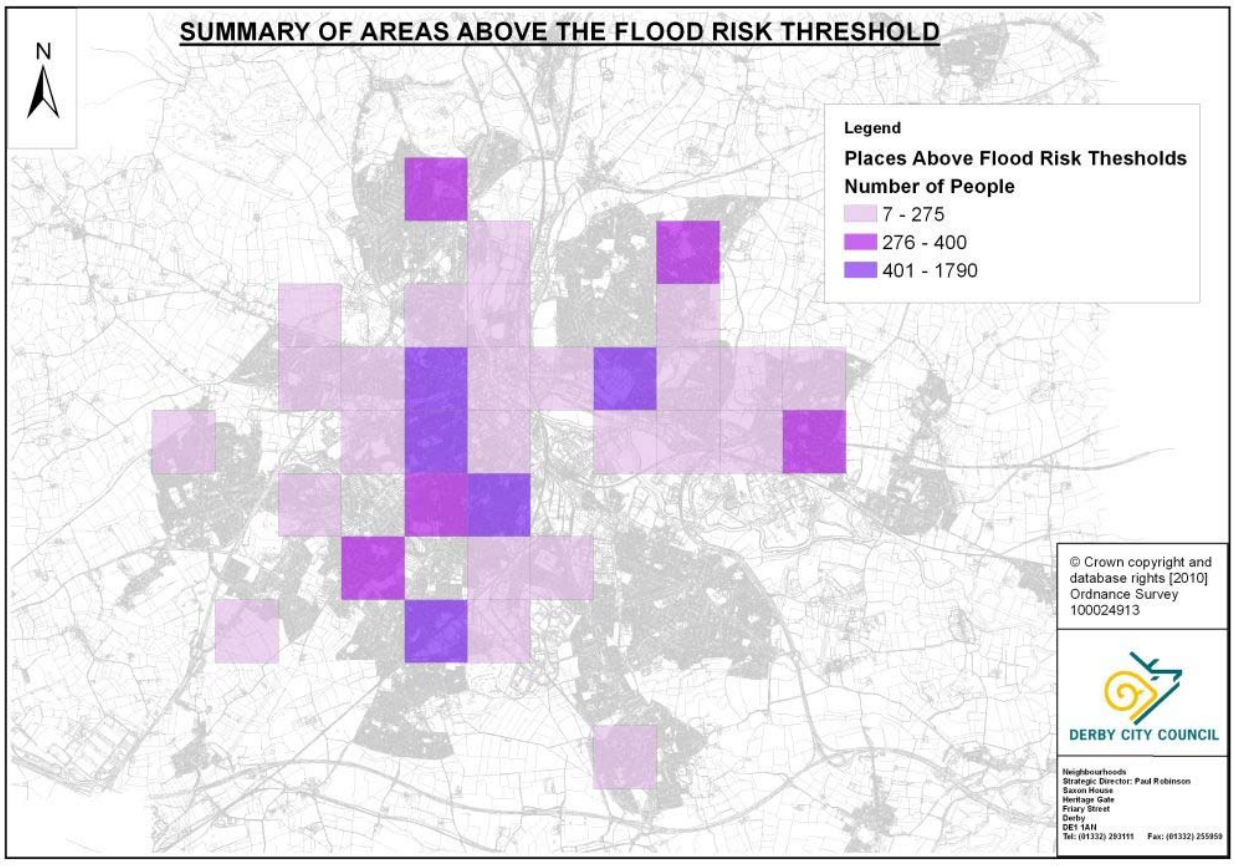

Figure 5.2 Summary Plan of Future Flooding

5.3 Storage of Future Records

DCC are currently involved in an extensive restructuring and the preparation of a new corporate IT system. Once complete it is intended that the public will have a single point of contact, therefore we are engaged in the design of a standard data entry form for the reporting of flooding instances. This may be available on the corporate website or at the telephone contact point, or both, however it is still early in the design of the new system and the discussion is ongoing.

5.4 Anticipated Effects of climate change

The effects and impacts of climate change are not fully understood, and are open to much debate. For the purposes of assessing future flood risk, information provided by the United Kingdom Climate Predictions 2009 (UKCP09) has been used to provide an insight into the possible effects.

There is clear scientific evidence that global climate change is happening now and cannot be ignored. Over the past century, around the UK, sea levels have risen and more winter rain falls in intense wet spells. Seasonal rainfall is highly variable and seems to have decreased in summer and increased in winter. Some of the changes might reflect natural variation, however, the broad trends are in line with projections from climate models.

Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s. There is enough confidence in large scale climate models to require a plan for change, and whilst there is more uncertainty at a local scale, model results can still help us plan to adapt. For example, rain storms may become more intense, however there is no certainty about exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance, or rarer) could increase locally by 40%.

5.4.1. Key Projections for Derby

If emissions follow a medium future (50% growth) scenario, UKCP09 projected precipitation changes for the 25km grid square 1353 (centred on Derby), over the period 2010-2039 (2020s) relative to the recent past are projected to be:-

- Mean winter precipitation increases of around 6%
- Mean summer precipitation is estimated to decrease by up to 7%
- Precipitation on the wettest day in winter up by around 5%
- Precipitation on the wettest day in summer is estimated to increase by up to 3%

5.4.2. Implications for Flood Risk

Climate changes can affect local flood risk in several ways, impacts will depend on local conditions and vulnerability.
Wetter winters and more rain falling in wet spells may increase fluvial flooding. More intense rainfall events, causing more surface runoff may increase localised flooding and erosion of soft areas. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so it is necessary to be prepared for the unexpected.

5.4.3. Adapting to Change

Historic CO_2 emissions mean that some climate change is inevitable. It is essential to respond by planning ahead and creating an understanding of current and future

vulnerability to flooding. The development of emergency plans to understand and improve local resilience to flooding is key to achieving long-term, sustainable benefits.

5.4.4. Long Term Developments

It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk.
In England, all new development proposals are assessed against a number of national and local planning policies, including PPS25. This aims to "ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."
Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria).

5.5 Proposed major development in Derby

As a LLFA and a SAB, Derby City Council aims to encourage all new developments to move towards a SuDS based approach to drainage. We have a good working relationship with our planning department and are a consultee on all new planning applications.

Derby City Council is working with the neighbouring authorities of Amber Valley Borough and South Derbyshire District Councils' to ensure that future development, primarily housing, is provided in a sustainable and co-ordinated location. Given that the city's boundary is tightly drawn around the urban area and that a number of watercourses flow through the city, the potential for future development within the city is a challenge.

Currently, applications are being considered on two large developments at Chellaston Business Park for employment uses and at Heatherton for residential. In the case of Chellaston, the site is located in an area of flood risk and the Local Planning Authority is working with the developer to help mitigate its impact. Additional large scale redevelopment schemes will be coming forward on brownfield sites within the city and some may have to take account of the impact of flooding and mitigate against it.

The Council's Core Strategy will contain a plan for the provision and location of new development sites. However, it is apparent that the level of anticipated growth cannot be entirely accommodated within the city's boundary and therefore locations outside of the city in Amber Valley and South Derbyshire will be considered.

Table 5.2 List of Planned Future Development in Derby

Development Title	Location	Type of development	Size	Current position
Rykneld Road	West of Heatherton, Littleover	Residential	About 980 dwellings	Current Housing application is in for 800 dwellings on most of the site
Friar Gate Goods Yard	Friar Gate, City Centre	Residential & employment	At least 500 dwellings, retail & leisure	Allocated in the Local Plan as a Mixed Use Regeneration Area Current application in for Supermarket, restaurants and up to 150 dwellings
Castleward	Castleward, City Centre	Residential & employment Urban Village	About 800 dwellings	Regeneration priority, master planned, with a preferred developer engaged, and a scheme for an urban village
Former Derbyshire Royal Infirmary	City Centre	Residential & employment	Up to 400 dwellings, retail & commercial	Regeneration priority with a planning application for a supermarket, business uses and up to 400 dwellings
Manor/Kingsway Hospitals	Littleover	Residential & employment	700 dwellings including 200 key worker units, business park	Allocated for Mixed Use Regeneration Area Is being marketed for development and is progressing.
Chellaston Business Park	Chellaston	Commercial & employment	90 Hectares	Outline Planning
Chaddesden Sidings	Chaddesden	Employment	28 Hectares	Allocated in the Master Plan
Osmaston Triangle	Sinfin	Mixed Use	9 Hectares	Master Planning stage. Council Priority for change

5.5.1. Proposed Re-establishment of the Derby and Sandiacre Canal

There is a proposal to re-establish the canal system in Derby. The proposal has recently been submitted for outline planning approval with a site specific Level 1 Flood Risk Assessment. The application provides an indicative horizontal alignment, but no details of the hydraulic management of water levels have yet been received. This development could have a significant impact on flood risk within Derby but could also provide the potential for flood routing within the city.

It will be necessary to work closely with the Derby and Sandiacre Canal Trust to ensure that the future flood risk for this development is fully assessed and managed. The proposal will be addressed further when the local Flood Risk Management Strategy for Derby is being developed and as increased design detail becomes available.

5.5.2. The Lower Derwent Flood Risk Management Strategy

The Environment Agency first released the Lower Derwent Strategy as a public consultation document in September 2008, the final strategy was published in January 2011 following relevant consultation. The main thrust of the strategy is to reduce flood risk across the Lower Derwent catchment (including Derby) over the next 100 years. However the strategy is also designed to offer wider environmental and social benefits. The strategy concentrates predominantly on fluvial flooding from the River Derwent which is beyond the scope of this assessment; however the proposed activities could influence surface water flood risk.

The activities proposed are grouped into three categories as follows:-

1. Continue and review existing activities
   The actions proposed in this category are generally a continuance of exiting activities which are undertaken to reduce fluvial flood risk from main rivers including the River Derwent which will have little impact on surface water flood risk within Derby.
   The exception to this is the proposal to control development through the use of PPS25 and to "continue to encourage the use of SuDS" which has the potential to reduce surface water flood risk within the city by controlling surface water discharge from new development and development on brown field sites.

2. Upstream land use and management
   The activities within this category are generally intended to reduce runoff from undeveloped land through encouragement of appropriate land management techniques. This in turn will lead to reduced flows in watercourses. It is likely that this will reduce surface water flood risk where such watercourses entire the city.

3 Provide flood defences and improve conveyance
   The actions proposed that impact direct on Derby City include: -

   - Improving flow through Derby Junction Railway Bridge (Five Arches Bridge)

   - Align defences to a new line through Derby City Centre to the optimum standard of protection. This is the category that offers the greatest potential for protecting properties from fluvial flood risk from the River Derwent within Derby City however the proposals also impact on surface water flood risk.

   Both above actions will lead to reduced peak water levels in the River Derwent which in turn will improve the efficiency of the sewer network by reducing sewer surcharge levels at submerged outfalls and therefore in this respect will reduce surface water flood risk to large areas of Derby. In contrast the raising and realignment of flood defences can interrupt surface water flood flow paths, with the possibility of increasing surface water flood risk in localised areas.

It is believed that when all the factors above are taken into consideration The Lower Derwent Strategy will have a positive impact on reducing surface water flood risk generally. However Derby City Council will work in partnership with the Environment Agency to assess more fully the impact on surface water flood risk at a local level to ensure that the impacts are fully considered.

6 Review of Indicative Flood Risk Areas

The PFRA is intended as a Europe-wide screening exercise to identify those areas at most significant risk of flooding. In order to achieve a consistent national approach for the United Kingdom, DEFRA and Welsh Assembly Government (WAG) have identified national significance criteria in order to identify particular "Flood Risk Areas". Guidance for the determination of these areas has been set out in the PFRA guidance document, however the following is a brief summary of the particular criteria involved.

- The whole of England and Wales has been divided into a 1km grid;
- The Environment Agency "FMfSW" (>0.3m depth range) has been identified as the critical threshold level to qualify properties and people at risk from surface water flooding within each cell;
- Where a particular cell has in excess of 200 people and/or more than 20 non-residential properties and/or one or more critical service at risk of flooding from surface water, the cell may be classified as a "place above the flood risk threshold". This means that the cell is vulnerable;
- Clustering analysis allows groups of adjacent cells to be classified into larger areas;
- Where a cluster of cells contains 30,000 people, or more, at risk from surface water flooding, this has been classified as an "Indicative Flood Risk Area"

The nationally identified "Places Above Flood Risk Thresholds" are based on the standard criteria set out by DEFRA, however they are based on a standard 1km grid square, set out across the country and may not be valid for every location. For instance, it is theoretically possible for a Flood Zone to fall into two or more grids and therefore not qualify in any one grid, but for it to have a suitable number of properties within the "at risk" category if considered in isolation. For this reason the ability exists for LLFAs to modify the standard Flood Risk Areas to accommodate geographic variations. If a LLFA wishes to adjust a grid square in order to include a specific flood zone, it must justify the change. There is also the question of whether or not this can be reconciled with the national grid layout, or how it should be considered if not.

Where flood risk areas do not fall into a 1km square grid, whether on a nationally set out grid or an arbitrary pattern, but still recognise significant flooding within an area (or catchment), these may be determined as Local Flood Risk Areas.

7 Identification of Indicative Flood Risk Areas

Using the criteria set out above, Derby does not currently fall within any nationally defined Indicative Flood Risk Areas. Furthermore, it is unlikely that this is liable to radically change since the total estimated number of people at risk of flooding for a 0.5% (1 in 200 probability) event in Derby is only 13,600 for the >0.3m depth range, and does not reach the minimum requirement of 30,000 per 5km square cluster. This stated, there are lesser areas which are prone to flooding and which are considered suitable for the definition of Local Flood Risk Areas.

8 Future Proposals

8.1 Proposed Measures for Improving Our Understanding

The following activities will allow us to enhance our knowledge of the mechanisms which cause flooding in Derby, and our ability to improve the service we provide:-

- Bramble Brook study – By completing the existing study we will be able to generate a digital model of the brook and catchment, and will be able to ascertain the likelihood for future flooding potential.
- Littleover Brook study – As for the Bramble Brook. It is also proposed to make long-term improvements to the open sections of the brook.
- EA modelling of 5 main watercourses – We will benefit from the modelling exercise and will hopefully be able to use the models to build a corporate model encompassing all brook courses.
- Undertake further investigations of past flooding to improve historic knowledge of past flooding in Derby, particularly the 1981 flood
- Incorporate information from the Derby SWMP when complete
- Data entry system -

8.2 Future Proposals for updating the PFRA

In order to fulfil their role as a LLFA DCC are proposing the following operations to ensure that the PFRA process is maintained and continued.

- Improving the method for recording flooding within the council to ensure full compliance with the INSPIRE Regulations 2009
- An annual review of flooding occurrences within the city
- Derby City has an extremely complex drainage system. There is a high degree of interaction between the sewer network, watercourses and flood relief culverts. In order to better understand how the network functions it is proposed to work with our partners particularly the Environment Agency and Severn Trent Water to investigate the practicality of merging the various hydraulic models that are being developed within the city into one integrated urban drainage model. This would lead to a far better understanding of the flood risk within the city.
- Working with our partners to investigate the possibility of improving the method of recording rainfall within the city.
- Research further detailed groundwater information

9 References

1. Flood Risk Regulations 2009 – DEFRA 2009

2. Flood and Water Management Act 2010

3. 2007 Census uk
http://www.statistics.gov.uk/census2001/cn_155.asp

3. Inspire Regulations 2009
http://www.legislation.gov.uk/uksi/2009/3157/contents/made

5. Derby City Council Level 1 Strategic Flood Risk Assessment (SFRA)

6. Environment Agency (2010) - Flood Map for Surface Water GIS layer and Property Count Method, available from:-
http://www.geostore.com/environment-agency

7. Selecting and reviewing Flood Risk Areas for local sources of flooding (Guidance to Lead Local Flood Authorities) – DEFRA 2009, available from:-
http://archive.defra.gov.uk/environment/flooding/documents/interim2/flood-risk-method.pdf

8. Preliminary Flood Risk Assessment - Final Guidance (GEHO1210BTGH-E-E), available from:-
http://publications.environment-agency.gov.uk/PDF/GEHO1210BTGH-E-E.pdf

9. Annexes to the final guidance document
http://publications.environment-agency.gov.uk/PDF/GEHO1210BTHF-E-E.pdf

10. Derbyshire County Council Preliminary Flood Risk Assessment

11. Environment Agency – Areas Susceptible to Groundwater Flooding (AStGWF) Notes for Guidance, available from:-
http://www.geostore.com/environment-agency

12. UK Climate Projections 2009 (UKCP09), user interface data available from:-
http://ukclimateprojections.defra.gov.uk/content/view/728/690/

10 Annexes

10.1 Annex 1 - Records of past floods and their significant consequences (Preliminary Assessment Report Spreadsheet)

Please refer to the attached spreadsheet.
According to the records currently available, Derby is not considered to have “significant harmful consequences” at a national level, however, there are recorded events which may be considered to be significant at a local level.

10.2 Annex 2 - Records of future floods and their significant consequences (Preliminary Assessment Report Spreadsheet)

Please refer to the attached spreadsheet.

10.3 Annex 3 - Records of Flood Risk Areas and their rationale

Using the methodology identified within this report, Derby does not fall within any indicative flood risk areas, therefore Annex 3 is not deemed to be applicable.

10.4 Annex 4 – Review Checklist

Annex 4 contains the Review Checklist supplied by the Environment Agency for the review of this submission.

10.5 Annex 5 – Supporting Data

The following data is included in support of the report:-
Derby City Flood History Database Shapefile – with specific address information removed