URS

Loughborough Surface Water Management Plan

FINAL REPORT

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ACRONYMS AND ABBREVIATIONS	
AAP	Area Action Plan
AEP	Annual Exceedance Probability
ASTSWF	Areas Susceptible to Surface Water Flooding
BGS	British Geological Survey
CAMC	Creating Asset Management Capacity
CaRT	Canal and River Trust
CBC	Charnwood Borough Council
CDA	Critical Drainage Area
CIRIA	Construction Industry Research and Information Association
CFMP	Catchment Flood Management Plan
CLG	Department for Communities and Local Government
Defra	Department for Environment, Flood and Rural Affairs
DEM	Digital Elevation Model
DSM	Digital Surface Model
DTM	Digital Terrain Model
EA	Environment Agency
FMfSW	Flood Map for Surface Water
FRR	Flood Risk Regulations
FWMA	Flood & Water Management Act
GIS	Geographical Information Systems
HCA	Homes and Communities Agency
IUD	Integrated Urban Drainage Study
JCS	Joint Core Strategy
LCC	Leicestershire County Council
LDF	Local Development Framework
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LRF	Local Resilience Forum

NE	Natural England
NFCDD	National Flood and Coastal Defence Database
NPPF	National Planning Policy Framework
NRD	National Receptors Database
NR	Network Rail
OS	Ordnance Survey
PFRA	Preliminary Flood Risk Assessment
PPS25	Planning and Policy Statement 25: Development and Flood Risk
RBMP	River Basin Management Plan
RFCC	Regional Flood and Coastal Committee
RSS	Regional Spatial Strategy
SAB	SuDS Approval Body
SFRA	Strategic Flood Risk Assessment
SPD	Supplementary Planning Document
ST	Severn Trent Water
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKCIP02	United Kingdom Climate Impact Programme 2002
WFD	Water Framework Directive

GLOSSARY	
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
Asset Management Plan	A plan for managing water and sewerage company (WaSC) infrastructure and other assets in order to deliver an agreed standard of service.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Civil Contingencies Act	This Act delivers a single framework for civil protection in the UK. As part of the Act, Local Resilience Forums must put into place emergency plans for a range of circumstances.
Critical Drainage Area	Areas of significant flood risk, characterised by the amount of surface runoff that drains into the area, the topography and hydraulic conditions of the pathway (e.g. sewer, river system), and the receptors (people, properties and infrastructure) that may be affected.
Culvert	A channel or pipe that carries water below the level of the ground.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
Flood Defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood and Water Management Act	Part of the Government's response to the Pitt Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Local Resilience Forum	A multi-agency forum, bringing together all organisations that have a duty to cooperate under the Civil Contingencies Act, and those involved in responding to emergencies. They prepare emergency plans in a co-ordinated manner.
Partner	A person or organisation with responsibility for decisions or actions that need to be taken.
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial Flooding	Flooding from water flowing over the surface of the ground; often occurs when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with additional flow.
Rate Support Grant	Funding mechanism from CLG to Local Authorities which provides funding for all Local Authority responsibilities.
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Sewer Flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Stakeholder	A person / organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
Sustainable Drainage Systems	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.

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1 INTRODUCTION

A Surface Water Management Plan (SWMP) is a document which outlines the preferred strategy (or strategies) for the coordinated management of surface water flood risk within a given area, in this instance the town of Loughborough in Leicestershire. In the context of a SWMP, surface water flooding incorporates flooding that may be derived from runoff from the land, ordinary watercourses, ditches, drains/sewers and groundwater, all of which could occur as a result of heavy rainfall.

The SWMP Technical Guidance issued by Defra in March 2010 emphasises that SWMPs may not be required in all locations. Studies should be prioritised in areas considered to be at greatest risk of surface water flooding where partnership working is essential to both understand and subsequently address issues relating to surface water flooding. Responsibility for managing flood risks from main rivers and the sea lies with the Environment Agency (EA), so this is not directly assessed for an SWMP.

This document presents a Phase I (Preparation), Phase II (Risk Assessment), Phase III (Options) and Phase IV (Implementation and Review) SWMP for Loughborough, comprising the sections shown in Figure 1-1.

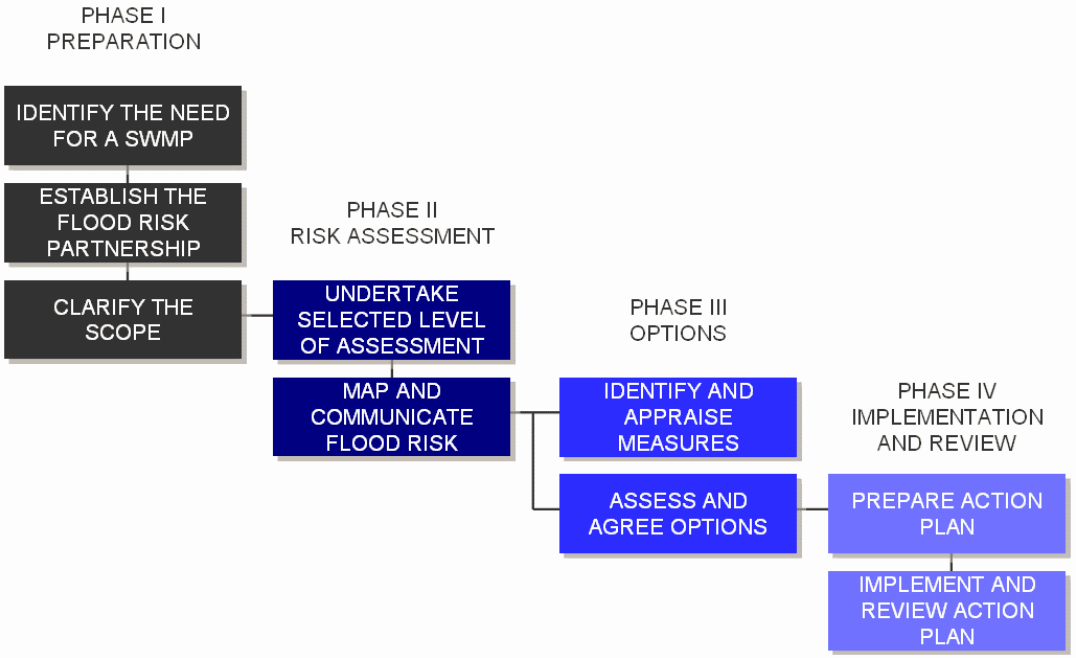


Figure 1-1: Surface Water Management Plan Phases

Based on research conducted by Defra in 2009, there are up to 4,200 properties at potential risk of surface water flooding within Loughborough and it is ranked 69th out of the 4,215 settlements assessed within England in the National Priority Ranking. This national scale assessment took into account estimation of future flood risk associated with climate change but did not account for proposed new development within Loughborough.

Flood risk policy has changed significantly in recent years, as a direct response to the severe flooding that occurred across England and Wales in July 2007. Although Loughborough was not badly affected by these events, surface water flooding within Loughborough was deemed significant within the Preliminary Flood Risk Assessment (PFRA) for the Easter 1998 floods. In addition, recent flooding (in June 2012) within Loughborough will contribute to further

understanding of surface water flooding issues and provide important lessons learned to mitigate flooding in the future. In his review of the Summer 2007 flooding, Sir Michael Pitt stated that:

> *"the role of local authorities should be enhanced so that they take on responsibility for leading the coordination of flood risk management in their areas".*

As the designated Lead Local Authority (LLFA), Leicestershire County Council (LCC) is therefore the responsible for leading local flood risk management across Leicestershire.

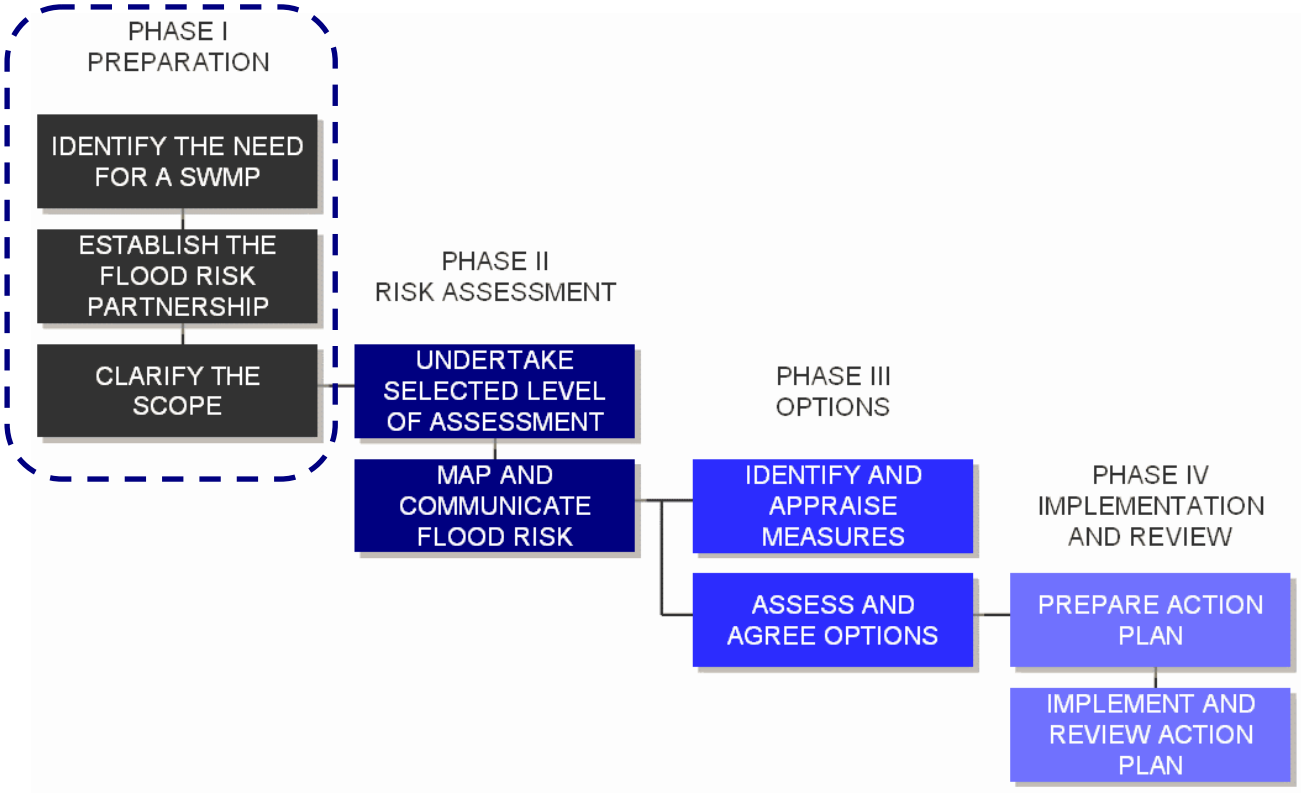
The Flood and Water Management Act 2010 (FWMA), which has been designed to put into place changes recommended by Sir Michael Pitt, states that the LCC, as the designated LLFA, has assumed new responsibilities for the management of surface water flood risk at the local scale. LCC are currently developing their Local Flood Risk Management Strategy (LFRMS) and has identified the requirement to develop an SWMP for Loughborough that builds on previous work. This will help to target appropriate pro-active mitigation measures for the management of surface water.

The main requirements of the SWMP as per the project brief are:

- To provide a strategic overview of surface water flood risk across Loughborough with detailed assessment of surface water risk at high risk locations, including identification and assessment of options and selection of preferred options for implementation;
- Map current and potential surface water flood risk areas, irrespective of source, and engage the community and all stakeholders to share this knowledge;
- Determine the consequences of surface water flooding, now and in the future, so that LCC can establish priorities and understand and compare the merits of different mitigation strategies;
- Identify effective, affordable , achievable and, cost-beneficial measures to mitigate surface water flood risk which achieve multiple benefits where possible;
- Develop a strategy to inform the strategic planning of drainage provision in large new developments;
- Develop an implementation plan showing how partners and stakeholders will work together to finance and implement the preferred strategy.

The following section of the report describes in more detail how the needs to undertake and deliver an SWMP were defined, and structure of the report.

PHASE I: PREPARATION



2 IDENTIFY THE NEED FOR A SURFACE WATER MANAGEMENT PLAN

2.1 Introduction

The principal output from a SWMP is a plan which outlines the preferred strategy for the coordinated management of surface water flood risk within a given area[1], in this instance Loughborough. The SWMP Technical Guidance issued by Defra in March 2010 emphasises that SWMPs may not be required in all locations. Studies should be prioritised in areas considered to be at greatest risk of surface water flooding or where partnership working is essential to both understand and address surface water flooding issues. Figure 2-1 shows the study area considered in this SWMP.

This chapter provides an overview of the rationale behind the preparation of an SWMP for Loughborough, on the basis of:

- The history of surface water flooding;
- The complexity of flooding mechanisms in Loughborough due to drainage system interactions;
- The fragmented nature of asset management;
- Proposed future urbanisation and redevelopment;
- The impacts of existing and emerging policy and legislation.

2.2 Stakeholder Engagement

For the purposes of the SWMP a stakeholder is defined as:

> *"anyone affected by the problem or solution or interested in the problem or solution. They can be individuals or organisations and include the public and communities."*

Stakeholders are often individual homeowners, but they can be organisations, the public and communities. Different stakeholders should be engaged to provide a rounded view of the problem and proposed solution.

As a consequence of the Summer 2007 floods, the Pitt Review emphasised the need for better communication with the public in relation to flooding and local flood risk management. This is in line with Government's promotion of localism and building better communities. It is the responsibility of LLFAs to ensure this happens, and an SWMP is one of the key mechanisms to ensure that this happens.

It is important that LCC (as the LLFA) liaise with stakeholders as part of an on-going process because stakeholders have often experienced flooding first hand and can provide invaluable information. Also, to ensure the smooth running and effective implementation of potential mitigation measures (especially those which may lead to local disruption, e.g. roadworks) stakeholder engagement is required from the start.

[1] Defra (March 2010) Surface Water Management Plan Technical Guidance www.defra.co.uk

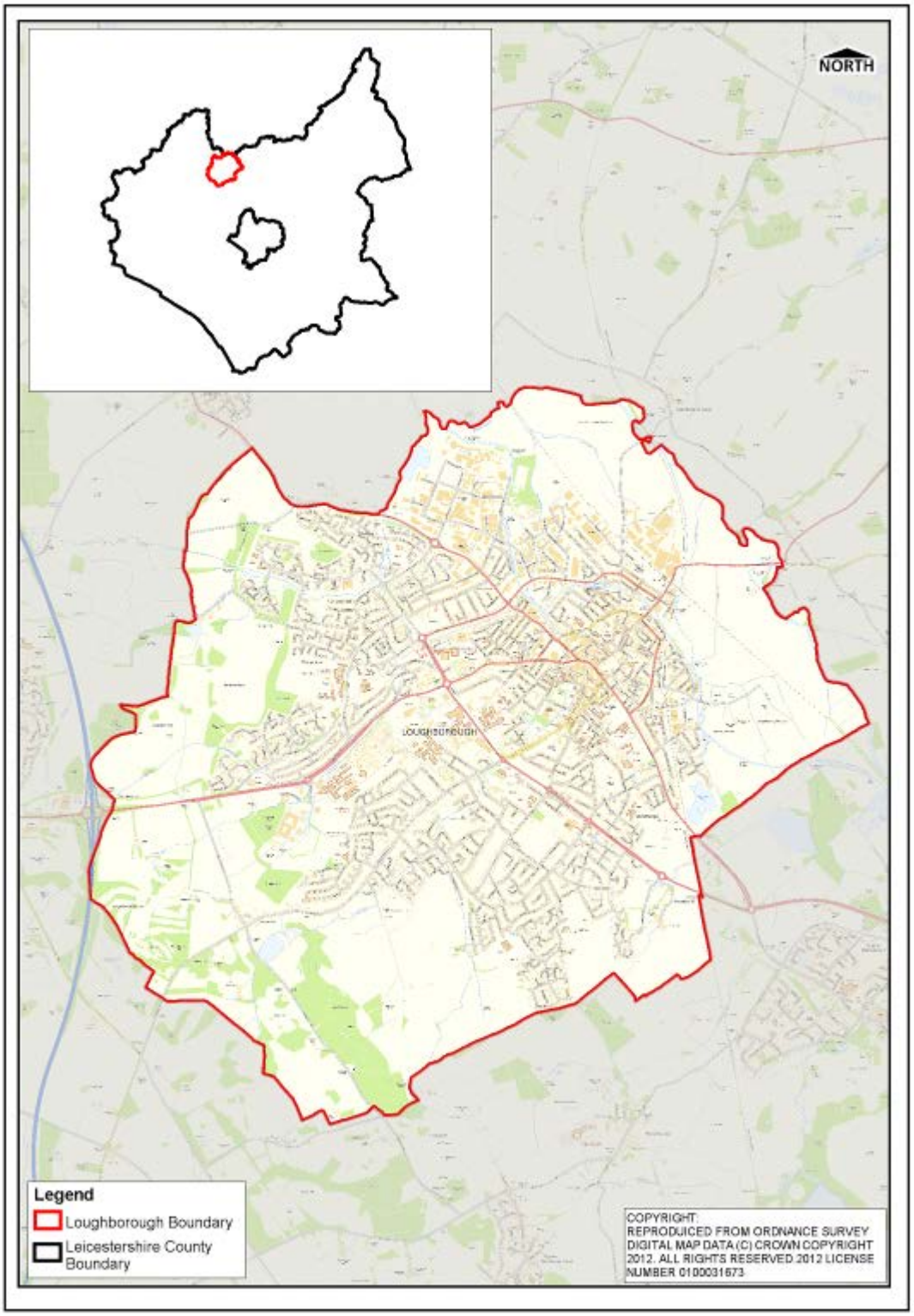


Figure 2-1: Study Area

The SWMP process supports liaison with local stakeholders throughout, however it also highlights the importance of managing their expectations.

As an SWMP continues to move forward into Phase III and Phase IV, local stakeholders should be contacted for their views on flood risk mitigation options and to exchange ideas about what they would like to see as potential outcomes.

The following engagement priorities are suggested to be taken forward by LCC:

- Engage stakeholders through the attendance of local community forums and meetings to raise the profile of flood risk;
- Provide a single point of contact at LCC for surface water drainage problems to be reported to (website/customer services page);
- Provide a newsletter/leaflet to promote schemes that LCC or CBC have completed, supported or funded in order to reduce existing and/or future flood risk;
- Formally engage with local stakeholders via public meetings at the options stage. This should include details of options, as well as information on how homeowners can protect themselves against flooding;
- Hold an open evening when different partners attend including the CBC, EA, Severn Trent Water (ST), Canal and River Trust (formerly British Waterways), Network Rail (NR) and other members/departments from LCC to describe what actions each organisation are taking and answer questions from the public.

3 CLARIFY THE SCOPE FOR THE SWMP

3.1 Structure

The principal output from an SWMP is an Action Plan which outlines the preferred strategy for the coordinated management of surface water flood risk within a given area.

The Defra SWMP Technical Guidance identifies four key phases of an SWMP as shown in Figure 1-1.

The first three phases involve undertaking the 'SWMP study', and subsequently the fourth phase involves producing and implementing an Action Plan that is founded on the evidence base of Phase I, Phase II and Phase III.

3.2 Aims and Objectives

The following objectives have been developed for each phase of the Loughborough SWMP:

Phase I – PREPARATION

- Identify the specific needs for an SWMP in Loughborough and determine the local project drivers;
- Review conflicts between growth aspirations and flood risk within Loughborough;
- Identify existing Flood Risk Partnerships and continue to develop a joint understanding of flood risk within Loughborough and overcome the division of responsibility in urban drainage;
- Collate and map existing information regarding flood risk from all sources;
- Determine an appropriate level of assessment for the Loughborough SWMP.

Phase II – RISK ASSESSMENT

- Review existing Loughborough Integrated Urban Drainage (IUD) modelling results to enable an intermediate assessment of surface water flood risk in Loughborough;
- Review the Flood Map for Surface Water (FMfSW) for those areas not covered by the Loughborough (IUD) modelling to identify the risks of surface water flooding by using the FMfSW to identify potential overland flow paths and areas of surface water ponding, enabling an assessment of people, properties and infrastructure at risk;
- Identify Critical Drainage Areas in collaboration with LCC and their professional partners;
- Communicate flood risks to relevant bodies within the Flood Risk Management Board (FRMB);
- Provide recommendations for detailed risk assessment if appropriate;
- Undertake an assessment of the risk of flooding in Loughborough due to groundwater.

Phase III – OPTIONS

- Initial identification of options for surface water management in Loughborough;
- Advise on 'early actions' or practical solutions that can be implemented;
- Advise on the potential for Integrated Drainage Strategies for strategic development sites.

The following objectives for Phase IV of the SWMP should be developed by LCC and the stakeholders:

Phase IV – IMPLEMENTATION AND REVIEW

- Provide focus towards the implementation and management of the recommendations determined in Phase I, Phase II and Phase III of the study;
- Provide a description of the available options;
- Set out requirements for the 'Action Plan' in conjunction with LCC.

4 FLOODING IN LOUGHBOROUGH

4.1 Surface Water Flooding in Loughborough

4.1.1 Defra Ranking

According to national research undertaken by Defra[2], there are up to 4,200 properties at risk of surface water flooding within Loughborough, ranking it nationally as 69th out of 4,215 settlements in Defra's National Priority Ranking.

4.1.2 Historical Surface Water Flooding in Loughborough

Surface water flooding and overland flow typically arise from intense rainfall, often of short duration, that fails to infiltrate the ground or enter drainage systems. As a result this can lead to local flooding by ponding or flowing over the ground surface. Local topography and built form can have a strong influence on the direction and depth of flow.

Pluvial/surface water flooding has historically, and continues to be, a significant issue in Leicestershire. The short duration and flashy nature of such events has made them difficult to predict and protect against. During the Summer of 2007, Leicestershire was not that badly affected by flooding caused by heavy rainfall across the UK. However, some records of surface water flooding are available. In relation to Loughborough, one major event occurred in 1998. Although insufficient detail has been obtained so far to sufficiently document the event, LCC believes that the severity of the flooding (which affected the majority of the town) makes this a nationally significant event.

4.1.3 Ordinary Watercourse Flooding

There are minor records of flooding from ordinary watercourses within Loughborough. According to the Charnwood Borough Strategic Flood Risk Assessment (SFRA), fluvial flooding along the River Soar has occurred within the Charnwood area due to natural out of bank flow. In most other cases, channel constrictions and obstructions appear to be the main cause of the fluvial flooding. Table 4-1 provides an indication about the main watercourses that are located within the area. These watercourses all pose potential flood risk to both existing and future developments, particularly those near the extensive floodplains of the larger, low gradient rivers e.g. the River Soar.

[2] National Rank Order of Settlements Susceptible to Surface Water Flooding, Defra 2009

TABLE 4-1: WATERCOURSES LOCATED IN LOUGHBOROUGH		
Watercourse	**Classification**	**Description**
River Soar	Main River	Source in south Leicestershire / north Warwickshire. Catchment collects water from a wide, primarily rural catchment, before passing through urban areas where it receives urban runoff. This river flows along the eastern boundary of Loughborough.
Black Brook	Main River	The Black Brook flows east through the north-west area of Loughborough prior to its confluence with the River Soar. According to the SFRA, this river has a rapid response to rainfall events.
Burleigh Brook	Main River / Ordinary Watercourse	The Burleigh Brook flows east through Loughborough prior to its confluence with the River Soar. The majority of the lower catchment is urbanised. The watercourse is taken under the Grand Union Canal (GUC) via a drop-culvert structure.
Wood Brook	Main River / Ordinary Watercourse	The source of the Wood Brook is located in Charnwood Forest. It then flows through Loughborough to the River Soar with the majority of the catchment urbanised. The watercourse is taken under the GUC via a drop-culvert structure.

According to the SFRA, a key flood risk location in Loughborough is associated with Wood Brook near the Town Centre and at the Belton Park Industrial Estate (flooding in 2000). It is also believed that properties along the Black Brook and Burleigh Brook could also be at risk.

It should be noted that any future development within the locality of an ordinary watercourse, especially development that will discharge to the ordinary watercourse, will be required to attenuate (or store) surface water runoff prior to discharge at agreed rates.

4.1.4 Sewer Flooding

Sewer flooding arises when the capacity of a sewer system is exceeded either as a result of a rainfall event which generates more water than can be accommodated in the sewer, or as a result of blockage in the sewer which prevents water from flowing. Both situations may result in a sewer overflowing or 'surcharging'.

Modern sewer systems are typically designed to accommodate rainfall events with a 1 in 30 year return period. However, older sewer systems tended not to be constructed to a specific design standard, and did not provide allowances for climate change; therefore some areas may be served by sewers with an effective design standard of less than 1 in 30 years. Consequently, rainfall events with a return period greater than 1 in 30 years would be expected to result in flooding of some parts of the sewer system.

As urban areas expand to accommodate new (and infill) growth, historically the original sewer systems were often not fully upgraded and had the potential to become overloaded. This problem is potentially compounded by climate change, which is forecast to result in milder wetter winters and increased rainfall intensity in summer months. The combination of these factors will increase the pressure on existing sewer systems, effectively reducing their design standard and increasing the frequency of flooding.

From a database of historical flooding provided by ST (FLOODS2), it was noted that there are records of sewer flooding at 24 individual locations across Loughborough, some of which have multiple records (the information provided is dated January 2011). The causes of

flooding (e.g. heavy rainfall, sewer blockage or capacity), and full descriptions of the consequences of flooding have generally not been recorded. It should be noted that recorded incidents do not necessarily present a definitive guide to sewer flood risk as different meteorological conditions affect different areas, and new areas may be at risk from the effects of future urbanisation and/or increases in flow (climate change). Nevertheless, database records of sewer flooding are an important aspect when considering planning development. Table 4-2 presents those locations that have multiple records of sewer flooding.

TABLE 4-2: SEWER FLOODING IN LOUGHBOROUGH

Location		
Beacon Road	Shelthorpe Road	Tiverton Road
Griggs Road	Nanpanton Road	Valley Road
Holt Drive	Loweswater Drive	

4.1.5 Groundwater Flooding

Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from abnormal springs. This often occurs after long periods of sustained high rainfall, and areas most at risk are those that are low lying where water the water table is at shallow depths. Groundwater flooding may take weeks or months to dissipate as groundwater flow is much slower than surface water flow and water levels take longer to recede.

The majority of Leicestershire is underlain by non-permeable/low permeability geology, so where groundwater exists it flows through strata slowly and in limited quantities. The River Trent Catchment Flood Management Plan (CFMP) produced by the EA states that groundwater flooding is considered to be only a minor issue within the Trent catchment. As a result, there is no localised groundwater incidents recorded within the Loughborough area.

4.1.6 Flooding from Artificial Sources

The Technical Guidance of the National Planning Policy Framework (NPPF) requires that artificial water sources, that have the potential to cause flooding within the study area, are identified as part of the SFRA. These include canals, reservoirs, ponds and any other features which hold water above the natural ground level.

In Loughborough, the town centre has been identified as a potentially vulnerable area to flooding from the canal if culverts are blocked or of insufficient capacity to contain runoff from significant rainfall events, causing flood water to back up. The canal is also thought to provide a potential flow path for higher flood levels in the River Soar, upstream of Loughborough into central Loughborough. The EA also identifies Loughborough as an area at risk from reservoir flooding.

4.2 Future Flooding

The United Kingdom Climate Projections 2009 (UKCP09) identifies that for future precipitation in the Loughborough area to 2080; the following may occur based the central estimate under the medium emissions scenario:

- Annual mean precipitation is likely to change by +1%, but is very unlikely to be less than -5% or more than +7%;
- Annual winter mean precipitation is likely to change by +19%, but is very unlikely to be less than +3% or greater than +41%;
- Annual summer mean precipitation is likely to change by -20%, but is very unlikely to be less than -43% or greater than +6%.

The risks of exceedance of the urban drainage system and surface water flooding in Loughborough is therefore likely to be affected by future changes, therefore mitigation and management needs to consider both current and future risks of flooding.

4.3 Fragmented Responsibilities

In areas of multiple sources of flood risk and complicated interactions between different sources of flooding, there are likely to be multiple water or drainage regulators, owners and maintainers. In Loughborough there are numerous partners with responsibility for decisions regarding drainage assets and areas at risk of flooding including:

- Leicestershire County Council;
- Environment Agency;
- Seven Trent Water;
- Charnwood Borough Council;
- Canal and River Trust.

It is essential that all relevant partners with responsibilities for making decisions and taking actions are involved in plans for flood risk management from the outset. A key aim of the SWMP for Loughborough is to strengthen the existing partnership between these organisations and ensure inclusivity through all phases of this study and future flood risk management of the area.

4.4 Existing and Emerging Legislation

Following severe surface water flooding in parts of England and Wales in July 2007, the Government commissioned Sir Michael Pitt to undertake an independent review into the causes and management of flood risk in the areas affected. The FWMA, which gained Royal Assent in April 2010, is designed to put into place the changes recommended by Sir Michael Pitt in his review and aims to reduce the risk and impact of flooding. These are principally to improve a LLFAs ability to manage the risk of flooding, improve water quality and reduce pollution.

The Flood Risk Regulations (FRR) 2009 came into force in December 2009 and is a set of regulations which translate the EU Floods Directive into law for England and Wales. The FRR bring the EA, County Councils and Unitary Authorities together with partners such as water companies to manage flood risk from all sources and to reduce the consequences of flooding on human health, economic activity, cultural heritage and the environment.

All these documents, Sir Michael Pitt's Review of the Summer 2007 floods, the subsequent, FWMA and the FRR, emphasise the need for LLFAs to embrace a leadership role for local flood risk management, ensuring that flood risk from all sources, including flooding from surface water, groundwater and small watercourses, is identified and managed as part of locally agreed work programmes.

In accordance with these recommendations and requirements, LCC has begun the process of preparing an SWMP for Loughborough.

5 DEVELOPMENT IN LOUGHBOROUGH

5.1 Core Strategy Status

The Borough of Charnwood Local Plan was adopted in 2004 and set out policies for future development. Subsequently, changes to national planning policy have required review of the existing Local Plan with a number of policies saved for an intervening period to September 2007. A number of these saved policies were extended beyond 2007. These policies remain and continue to inform decisions for planning applications. Existing policies will be reviewed and eventually replaced by the new Charnwood Local Plan once adopted.

The Core Strategy is the first Local Plan document to be prepared with an adoption date aimed for December 2013. This strategy will set out strategic policies to deliver the council's vision for Charnwood up to 2028. It will also address spatial implications of the Sustainable Community Strategy. Other documents being prepared as part of the Local Plan include the Site Allocations and Development Management Policies development plan which will identify sites in the borough that need to accommodate the range of land uses necessary to implement objectives of the Core Strategy. This is due to be adopted in February 2015.

In terms of future development, the Core Strategy Supplementary Consultation document (June 2012) contains discussions regarding potential development options. It is important to emphasise that no decisions have been made about the proposed Sustainable Urban Extensions (SUEs), however development options have been put forward based on the Proposed Housing Distributions (Table 5.1).

TABLE 5.1: PROPOSED HOUSING DISTRIBUTIONS (FROM CORE STRATEGY SUPPLEMENTARY CONSULTATION DOCUMENT)

Area	Housing Requirement (2006-2028)	Houses built or with planning permission (2006-2012)	Housing proposed in Sustainable Urban Extensions (2006-2028)	Housing Shortfall to be found (2006-2028)
Principal Urban Area	7,260	1,367	3,750 (of a total of 4,500)	2,143
Non-principal Area	10,120	6,307	2,500 (of a total of 3,000)	1,313
Charnwood Total	17,380	7,674	6,250 (of a total of 7,500)	3,456

Table 5.1 includes options across the whole of the administrative area for CBC. Within the north of Charnwood, a number of options are being considered for future housing development relevant to Loughborough, these include:

- Option A - Identify an additional direction of growth south of Loughborough;
- Option B - Identify an additional direction of growth south west of Loughborough;
- Option C - Identify an additional direction of growth east of Loughborough;
- Option E - Concentrate additional development in Loughborough & Shepshed and identify sites through the Site Allocations Development Plan document.

Within the consultation document it is noted that Option C is considered to have the potential to have a significant negative effect against the sustainability appraisal objective of reducing vulnerability to flooding.

Future development options should take account of the need to manage surface water and not increase the risk to others. The work undertaken within this SWMP will contribute to further understanding both the existing and future challenges faced from surface water flood risk within Loughborough. In addition, it will aid the development of appropriate policies to reduce the impact of surface water flooding and provide additional benefits through links with other policies and plans.

6 FLOOD RISK MANAGEMENT BOARD

6.1 Overview

In order for the SWMP study and future flood risk management more generally within Loughborough to be successful, it is essential that relevant partners and stakeholders, who share the responsibility for necessary decisions and actions, work collaboratively to understand existing and future surface water flood risk within Loughborough.

Existing work undertaken by LCC (Multi-Agency Flood Plan, Preliminary Flood Risk Assessment, and Loughborough Integrated Urban Drainage Study) has led to collaborative working and development of a working relationship between relevant partners forming the basis of the FRMB, these include representatives from:

- Leicester County Council, including multi-departmental representation including:
  - Environmental and Transport Planning;
  - Strategic Planning / Planning Policy;
  - Emergency Planning;
- District Councils (including Charnwood Borough Council);
- Environment Agency;
- Water company (i.e. Severn Trent);
- Fire and Rescues, Police and Ambulance Services[3].

Whilst the FRMB recognises that each authority has specific responsibilities under the legislation, it will ensure that a joint approach is taken, wherever reasonable, on all aspects of flood risk management in the Leicestershire area. The FRMB's responsibilities will include, but will not be limited to, the following aspects:

- Flood risk assessments and studies;
- Flood risk management strategies;
- Sustainable drainage;
- Planning and flood risk;
- Resilience;
- Training and capacity building;
- Funding.

Systems will be created to enable the optimum sharing of data on each partner's infrastructure in order to provide the best benefit for communities. Information that is shared will help highlight potential problems and identify potential opportunities for collaborative working to resolve issues and address other challenges.

It is proposed that a second tier of the FRMB is expanded to potentially include partners identified in Figure 6-1.

[3] Represented by the LRF co-ordinator.

Figure 6-1: Suggested Members of the Loughborough FRMB

6.2 Benefits of Collaborative Working

Multiple and mutual benefits will arise from collaborative working between members of the FRMB, including:

- Exchange of knowledge and greater understanding of urban drainage for a range of organisations;
- A shared understanding of flood risk between the principal partners of FRMB (as well as the second tier partners):

  - Leicestershire County Council;
  - Charnwood Borough Council;
  - Environment Agency;
  - Severn Trent Water;
- Efficiency savings for 'essential partners' through achieving outcomes;
- Appraisal of surface water drainage options;
- Greater certainty for developers concerning appropriate drainage;
- Quicker, more certain decisions on development and infrastructure provision;
- Overall reduction in flood risk in Loughborough, primarily driven through the latter SWMP phases (Phase III and Phase IV) – dependent upon available funding.

7 DATA COLLECTION AND REVIEW

7.1 Data Collection

A series of datasets relating to flooding within Loughborough that will assist with the development of the SWMP have been drawn together. Table 7-1 summarises the data that has been collected.

TABLE 7-1: DATASETS COLLECTED

Dataset	Provider
Flood Zone Maps	Environment Agency
Areas Susceptible to Surface Water Flooding Maps	
Flood Maps for Surface Water	
Areas Susceptible to Groundwater Flooding	
Main River Centrelines	
Historic Flood Map	
River Trent Catchment Flood Management Plans	
Strategic Flood Risk Assessments	Charnwood
Historical flooding records	
Anecdotal information relating to local flood history and flood risk areas	
Highways flooding records	Leicestershire County Council
Ordnance Survey Mapping	
Historical sewer flooding database	Severn Trent Water
Canal network	Canal & River Trust
Records of canal breaches and overtopping events	
Other relevant datasets	Network Rail; Homes & Communities Agency
	Natural England; Major Developers; BGS

7.2 Data Review

One of the key components of understanding local flood risk is the sharing of flood risk data between and across organisations. This section sets out the results of our comprehensive data collection and review.

Data have been collated, recorded and analysed, chiefly by URS. The collected data have been recorded in a project data register which documents the source of the data and its completeness. In line with the SWMP technical guidance, the quality of the data has been scored using the following classifications:

1. No known deficiencies - not possible to improve in the near future,
2. Known deficiencies – best replaced as soon as new data are available,
3. Assumed – based on experience and judgement,
4. Grossly assumed – an educated guess.

7.3 Linkages with Other Plans

It is important that the SWMP is not viewed as an isolated document, but one that connects with other strategic and local plans. Figure 7-1 shows URS's interpretation of the drivers behind the Loughborough SWMP, the evidence base and how the SWMP supports the delivery of other key spatial planning and investment processes.

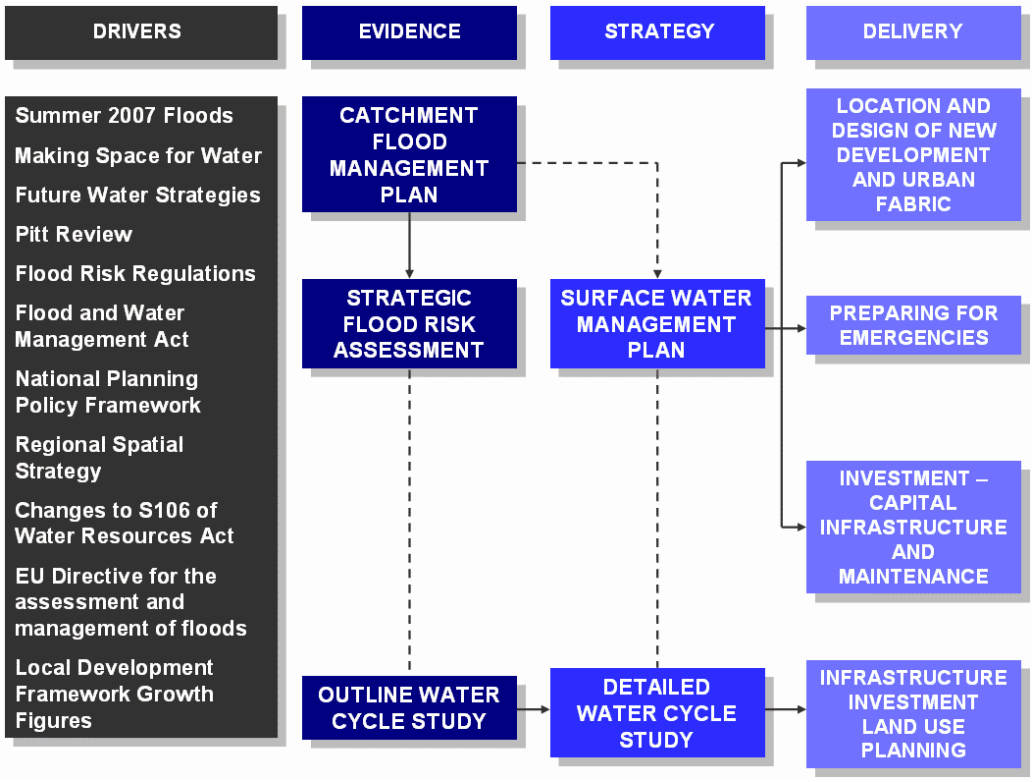


Figure 7-1: 'Where SWMPs Fit In'

7.4 Environment Agency Plans

7.4.1 River Basin Management Plans

The River Basin Management Plan for the Humber River Basin District focuses on the protection, improvement and sustainable use of the water environment. The plan describes the River Basin district, along with the pressures that the water environment faces. It shows what this means for the water environment and what actions are required to address the current pressures. The plans also sets out what improvements are possible by 2015 and how the actions will make a difference to the local environment – the catchments, the estuaries and coasts and groundwater. These plans have been developed in consultations with a wide range of organisations and individuals and are the first of a series of six-year planning cycles. Once the first cycle ends in 2015, further planning and consultation will take place and the plan will be updated and reissued.

7.4.2 Catchment Flood Management Plans

The River Trent Catchment Flood Management Plan (CFMP) provides an overview of the flood risk in the river catchment and sets out a preferred plan for sustainable flood risk management over the next 50-100 years, taking climate change into account.

Loughborough lies within the Upper Soar and Upper Anker (Sub-Area 9) Policy Unit of the River Trent CFMP. The vision and preferred approach for this Policy Unit is:

> *"Policy Unit 4 – Areas of low, moderate or high flood risk where we are already managing flood risk effectively but where we may need to take further actions to keep pace with climate change."*

The key messages for the (Sub-Area 9) Policy Unit are:

- Assess long-term opportunities to move development away from floodplains and create green river corridors through parts of Leicester;
- Work with others to minimise disruption to people and communities caused by flooding, taking into account future climate change and urban growth;
- Work to minimise the cost of flood damage in Nuneaton, Leicester and Loughborough, taking into account future climate change and urban growth;
- Return watercourses to a more natural state, increasing biodiversity and opening up green river corridors through urban areas of Leicester;
- Sustain and increase the amount of BAP habitat in the catchment.

Proposed actions to implement the preferred policy include providing a more accurate and community focused flood warning system, supporting the production and implementation of an integrated drainage strategy for urban areas, investigate opportunities for creating green corridors along watercourses in urban centres and investigate upstream storage for 'at-risk' urban centres.

7.5 Loughborough Plans

7.5.1 Core Planning Strategy

The Core Strategy is currently being prepared as part of the Charnwood Local Plan which will replace the existing plan. This strategy will set out the strategic policies for the Borough for

meeting the economic, environmental and social needs up to 2028. It will also identify areas suitable for SUEs.

7.5.2 Preliminary Flood Risk Assessment and Level 2 Strategic Flood Risk Assessment

A Preliminary Flood Risk Assessment (PFRA) was produced for LCC as required in accordance with the FRR. The PFRA provides a high level summary of significant flood risks, considering surface runoff, groundwater and ordinary watercourses. In addition, a Level 2 SFRA was produced for CBC which focuses more on Loughborough and its surrounding area. This SFRA was produced to inform the Local Development Framework (LDF) and Sustainability Appraisal (SA) of flood risk issues as well as the location of future development. The SWMP will build upon findings in these assessments with respect to surface water flood risk.

7.6 Multi-Agency Flood Plan

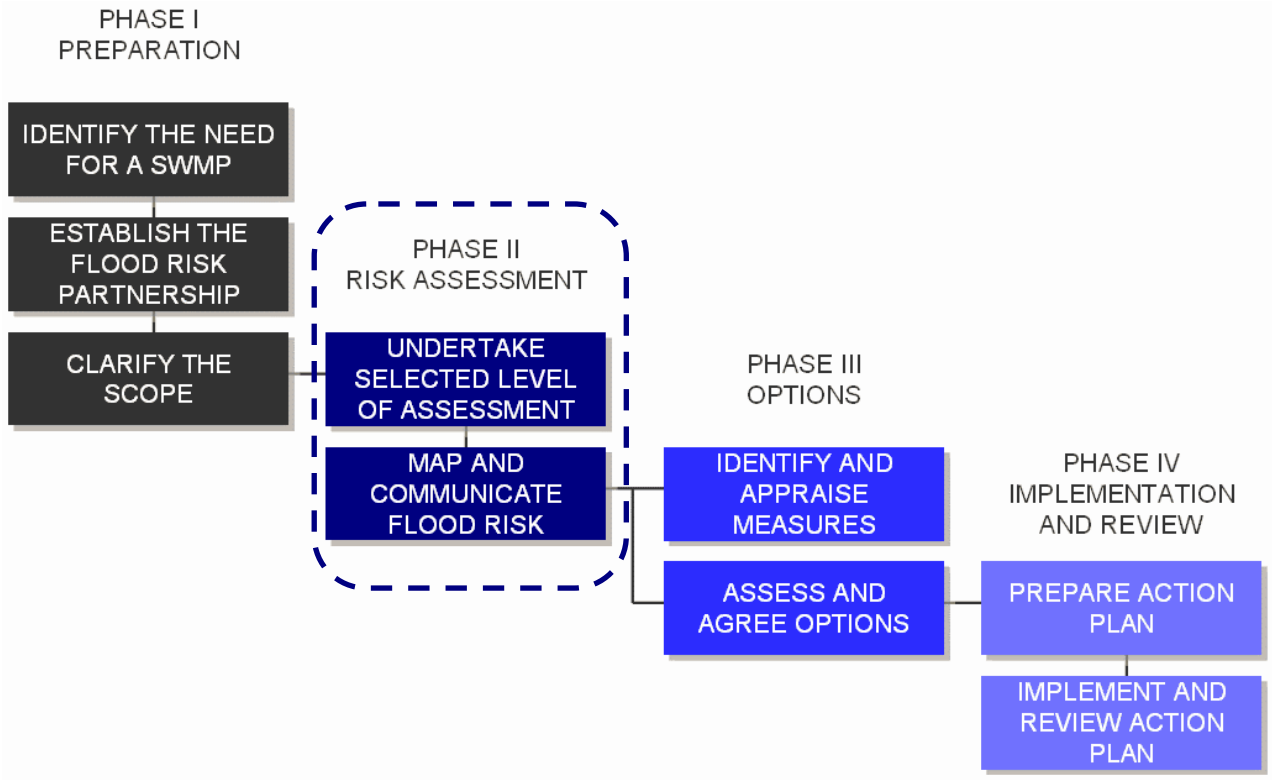
The Leicester, Leicestershire and Rutland Local Resilience Forum (LRF) developed a Multi-Agency Flood Plan for the wider area that was released in 2010. Relevant findings from this SWMP should be incorporated by Emergency Planners into future updates of the Multi-Agency Flood Plan where necessary.

7.7 Severn Trent Water Plans

During the preparation of this SWMP, documents and plans have not been received from ST, except for (GIS) network layers and an extract from the DG5 register. Documents that would be useful to the FRMB, where available, include the following:

- Drainage Area Plan;
- Sewerage Management Plan;
- Asset Management Plan.

PHASE II: RISK ASSESSMENT



8 PHASE II SCOPE

8.1 Aims and Objectives

The purpose of the Phase II 'Risk Assessment' is for key stakeholders (in this case LCC, CBC, ST and the EA) to develop and enhance their understanding of the surface water (and local) flood risk in Loughborough and subsequently, to communicate this risk to relevant parties.

The specific objectives of Phase II of the SWMP for Loughborough are to:

- Develop and implement a suitable approach to enable an intermediate assessment of surface water flood risk in Loughborough;
- Quantify the risks from surface water flooding through the identification of overland flow paths and areas of surface water ponding leading to an assessment of people, properties and infrastructure at risk;
- Quantify the risks from other sources of flooding within Loughborough;
- Map flooding data-sets to build an overall picture of flooding from sources investigated;
- Work with the key stakeholders to collate and share flood risk information;
- Engage local communities to access to additional local knowledge, build trust and increase the chances of stakeholder acceptance of options and decisions proposed through the SWMP;
- Communicate flood risks to relevant bodies within the FRMB;
- Identify CDAs for further consideration during the Phase III Options Assessment;
- Provide recommendations for detailed risk assessment if appropriate.

In order to achieve these objectives, the following elements of work have been undertaken:

- Review of existing data collated in Phase I;
- Review outcomes of Loughborough IUD study;
- Review FMfSW (and compare with IUD outputs);
- Review of data relating to the existing sewer system from ST;
- Undertake a desk based groundwater assessment of Loughborough.

The findings of these assessments are described in the following chapters, which consider each of the following sources of surface water flooding in turn:

- **Surface runoff and/or ponding**; runoff as a result of high intensity rainfall (that exceeds ground infiltration capacity) when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity, thus causing flooding (known as pluvial flooding);
- **Sewer flooding**[4]**;** flooding which occurs when the capacity of the underground network system is exceeded, resulting in flooding inside and outside of buildings. Normal

[4] Consideration of sewer flooding in 'dry weather' resulting from blockage, collapse or pumping station mechanical failure is excluded from SWMPs as this if for the sole concern of the sewage undertaker.

discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters[5] or as a result of wet weather;

- Flooding from **small open channels** and **culverted urban watercourses**[6] which receive most of their flow from inside the urban area and perform an urban drainage function;
- Overland flows resulting from **groundwater sources**.

[5] Interactions with larger watercourses can be an important mechanism in controlling surface water flooding.
[6] These watercourses will frequently be ordinary watercourses (within the responsibility of local authorities) but may also be designated Main River (with responsibility of the Environment Agency).

9 PLUVIAL FLOODING

9.1 Overview

Pluvial flooding occurs when high intensity rainfall generates runoff which flows over the surface of the ground and ponds in low lying areas. It occurs when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with the additional flow (Figure 9-1).

Figure 9-1: Pluvial Flooding within the Urban Environment
Source: URS (Defra Urban Blue Corridors Study, 2010)

There are limited records of pluvial flooding within the Loughborough area. According to the Leicestershire PFRA, one significant event was included within Loughborough which occurred in 1998. Although insufficient data has been obtained so far to adequately document the event, based on its severity, the event is considered a nationally significant event.

Records provided by ST indicate several critical areas where there have been issues with surface water drainage systems. Beacon Road (combined sewer), Holt Drive (combined sewer) and Tiverton Road (surface water sewer) are al areas which have had multiple instances of flooding relating to the sewer system.

Recent rainfall events have caused significant pluvial flooding issues. In 2012 sections along Derby Road, Alan Moss Road and Limehurst Avenue caused large disruptions in Loughborough, with properties and local businesses affected by flood water.

9.2 Pluvial Flooding Data Review

9.2.1 Topography

The topography of Loughborough is shown in Figure 9-2. Loughborough lies to the west of the River Soar with a number of small catchments draining eastwards into the River Soar. Elevations are typically between 80 mAOD and 100 mAOD in the west reducing to approximately 35 mAOD to 40 mAOD in the east.

Figure 9-2: Topography of Loughborough Area

There are steeper slopes in the headwater areas of the catchments and are predominantly rural. These form flow paths for surface runoff, and subsequently pluvial flooding (or ponding) at lower elevations within the urban area of Loughborough. In particular, where watercourses have been culverted or obstructions to flow paths have been introduced within the urban environment, pluvial flooding is likely to occur.

9.2.2 National Pluvial Modelling

The EA has undertaken pluvial modelling at a national scale and produced mapping identifying areas considered vulnerable to surface water flooding. The mapping relevant to Loughborough is provided in Figure 9-3 (Areas Susceptible to Surface Water Flooding (ASTSWF)), Figure 9-4 (Flood Map for Surface Water (FMfSW), 30 year) and Figure 9-5 (FMfSW, 200 year). The primary purpose of these maps is to assist LPAs with emergency planning procedures and it should be noted that this national mapping has the following limitations:

- The mapping does not show the interface between the surface water network, the sewer systems and the watercourses;
- It does not show the susceptibility of individual properties to surface water flooding;
- The mapping has significant limitations for use in flat catchments.

The mapping provides national coverage and has been produced using a simplified method that excludes drainage networks (but provides an allowance for loss rates), excludes building footprints, and uses a simplified rainfall profile and event duration for two return periods. It is noted that this mapping is intended for use by the LRFs solely to inform emergency planning and should not be used for spatial planning decisions. In addition, the EA strongly recommends that local knowledge is applied to assess the suitability of the mapping as an indicator of surface water flooding before emergency planners make decisions based upon it.

In the light of these recommendations, the mapping has been used as an indicative overview of pluvial flood risk across Loughborough which is being reviewed in conjunction with local knowledge of pluvial flooding incidents to form a platform for the intermediate risk assessment, including information from a more detailed Integrated Urban Drainage (IUD) study.

The mapping shown in Figure 9-3 is typically more representative of surface water flood risk in flat areas, which are prone to flooding as result of an accumulation of water during a long rainfall event. The mapping shown in Figure 9-4 and Figure 9-5 is typically more representative of surface water flood risk in steeper areas, where short, yet high intensity rainfall is often more problematic and as such is likely to be more realistic for Loughborough that has a series of small catchments within the wider area. In addition, the Leicestershire PFRA, in agreement with the EA identifies that the FMfSW is the ‘locally agreed’ surface water information that best represents known flooding within the wider area.

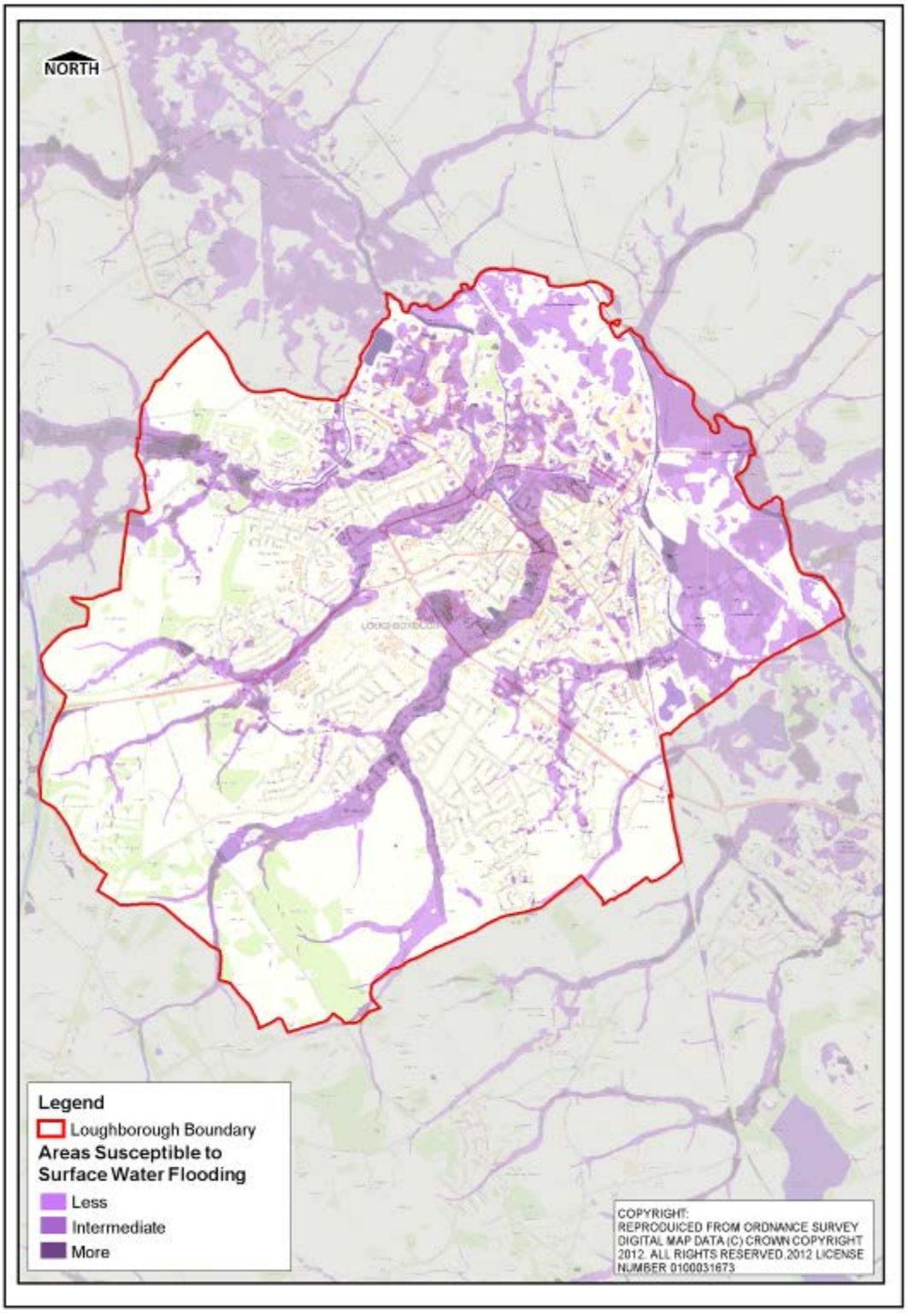


Figure 9-3: Areas Susceptible to Surface Water Flooding

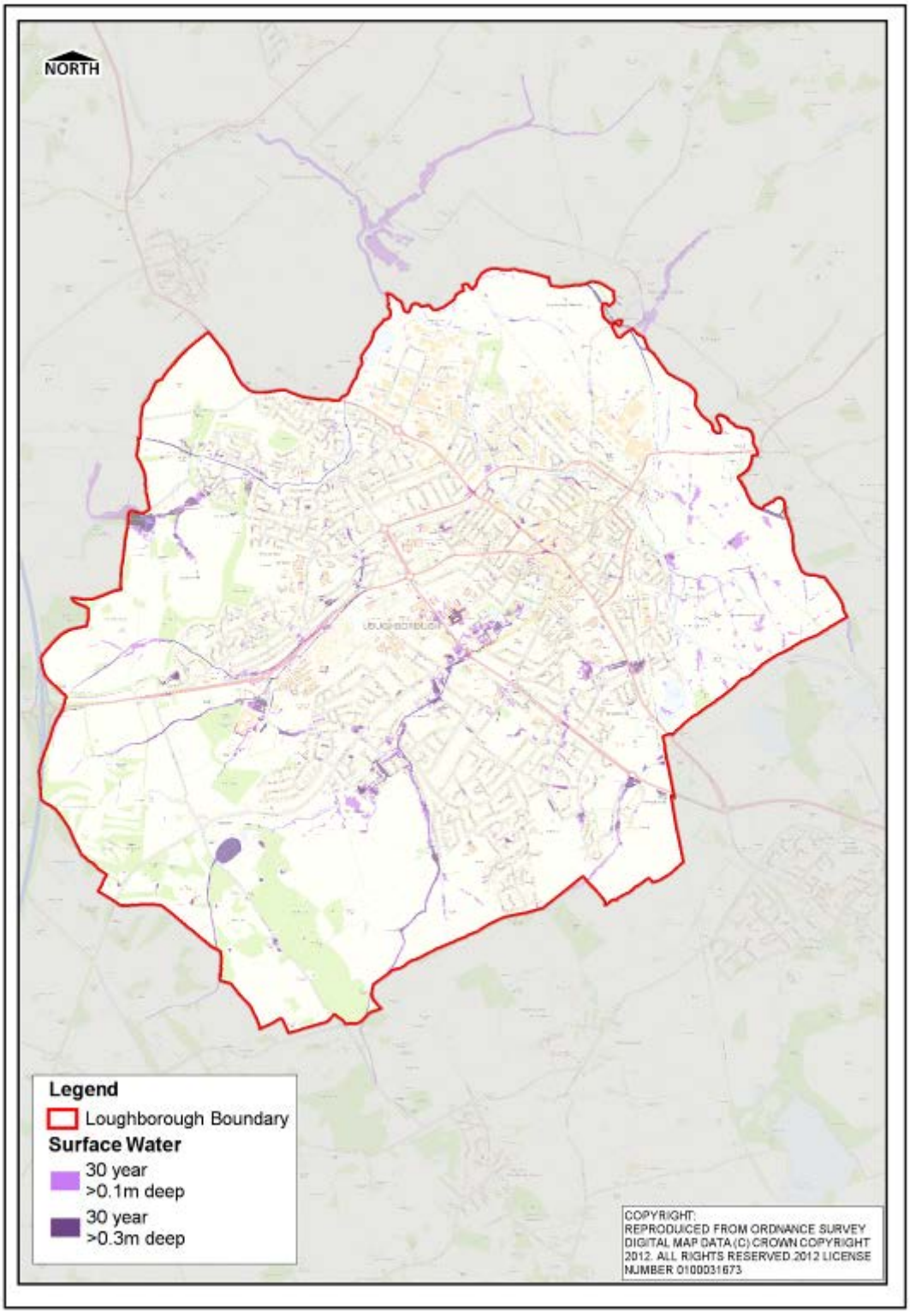


Figure 9-4: Flood Map for Surface Water – 1 in 30 year rainfall event

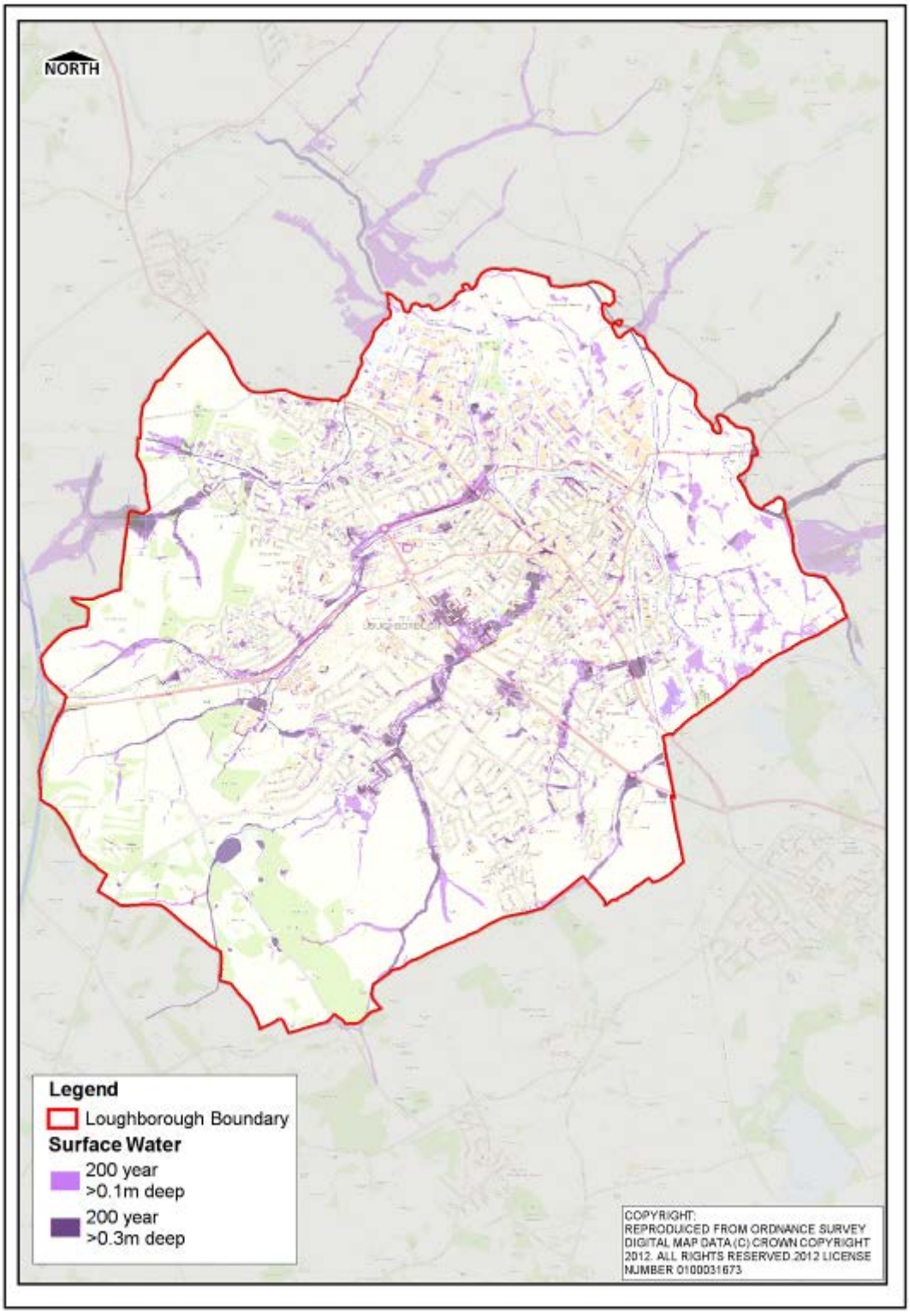


Figure 9-5: Flood Map for Surface Water – 1 in 200 year rainfall event

10 LEVEL OF ASSESSMENT FOR LOUGHBOROUGH

10.1 Levels of SWMP Assessment

SWMPs can function at different geographical scales and therefore necessarily at differing scales of detail. Table 10-1 defines the potential levels of assessment within an SWMP.

LCC, based on strategic level mapping at a broad scale and known issues has identified the requirement for an 'Intermediate Level Assessment'. At a localised level, more detailed work has been undertaken as part of an IUD study within Loughborough for two individual catchments. The findings of the IUD study have been utilised alongside Loughborough wide data to produce the Intermediate Level Assessment.

TABLE 10-1: LEVELS OF ASSESSMENT (DEFRA, 2010)

Level of Assessment	Scale	Outputs
1 – Strategic	Sub-Regional (i.e. Leicestershire)	• Broad understanding of locations that are more vulnerable to surface water flooding; • Prioritised list for further assessment; • Outline maps to inform spatial and emergency planning.
2 – Intermediate	**City / Borough /District (i.e. Loughborough)**	• **Identify flood hotspots which might require further analysis through detailed assessment;** • **Identify immediate mitigation measures which can be implemented;** • **Inform spatial and emergency planning.**
3 – Detailed	Known flooding hotspots	• Detailed assessment of cause and consequences of flooding; • Use to understand the mechanisms and test mitigation measures, through modelling of surface and sub-surface drainage systems.

10.2 Selected Level of Assessment for Loughborough

10.2.1 Intermediate Assessment

As shown in Table 10-1, the Intermediate Assessment is applicable across a large town, city or borough/district. In the light of the nature of surface water flooding across Loughborough identified at strategic level and the number of properties at risk (as estimated by Defra), it is appropriate to undertake an Intermediate Assessment to further quantify the risks whilst incorporating the findings of the IUD study undertaken in 2011.

The purpose of this Intermediate Assessment is to further identify parts of Loughborough that are likely to be at greater risk of surface water flooding and incorporate the more specific work undertaken as part of the IUD study.

The outputs from this Intermediate Assessment should be used to update spatial and emergency planning and to identify potential mitigation measures including quick wins which can be implemented to reduce surface water flooding. These may include improved maintenance and clearance of blockages.

10.3 Method used for Intermediate Assessment

In order to continue to improve understanding of the causes and consequences of surface water flooding in Loughborough, analysis of the Environment Agency FMfSW has been undertaken. In addition, outputs of the Loughborough IUD study have also been incorporated.

10.3.1 Approach

The FMfSW produced by the A has been used in the analysis of surface water flooding potential. The FMfSW is a Direct Rainfall approach (Figure 10-1) where rainfall applied directly to a DTM for two rainfall events. The water is then routed over the DTM to provide an indication of potential flow paths and associated maximum depths.

Rolling Ball	Surface water flow routes are identified by topographic analysis, most commonly in a GIS package.
Direct Rainfall	**Rainfall is applied directly to a surface and is routed overland to predict surface water flooding.**
Drainage Systems	Based around models of the underground drainage systems.
Integrated Approach	Representing both direct rainfall and drainage systems in an integrated manner, or linking different models together dynamically.

Figure 10-1: Levels of Pluvial Modelling [SMWP Technical Guidance, Defra 2010]

Rainfall events with the following return periods were modelled by the EA:

- 1 in 30 year event;
- 1 in 200 year event.

10.3.2 FMfSW Outputs

The FMfSW mapping has been provided by the EA (through LCC) in GIS format. These have been provided for both return periods (1 in 30 year and 1 in 200 year) and illustrate areas where potential depths of surface water flooding greater than 0.1 m and greater 0.3 m are likely to occur (see Figure 9-4 and Figure 9-5).

It is anticipated that these maps should be used to engage stakeholders on surface water flooding issues, to inform the spatial planning process, to inform future capital investment decisions (at a strategic level), to inform emergency planning functions carried out by LRFs, and to identify whether critical infrastructure is at risk from surface water flooding.

As described in Section 9.2.2 the limitations associated with the method used in the production of the FMfSW should be understood when using this information.

10.4 Historical Flooding and Maintenance Records

LCC and ST have provided records of historical flooding across Loughborough, which range from internal property flooding to garden and highway flooding. These incidents have been geo-referenced and mapped over the national pluvial modelling dataset and are presented in Figure 10-2 and Figure 10-3.

In addition, historical flood extents from fluvial flooding has also been plotted to illustrate areas where potential flooding from combined sources may present an issue. GIS analysis has confirmed that in the majority of locations, these incidents correlate with the FMfSW. In addition, these were previously used in the identification of the two catchments investigated as part of the Loughborough IUD study.

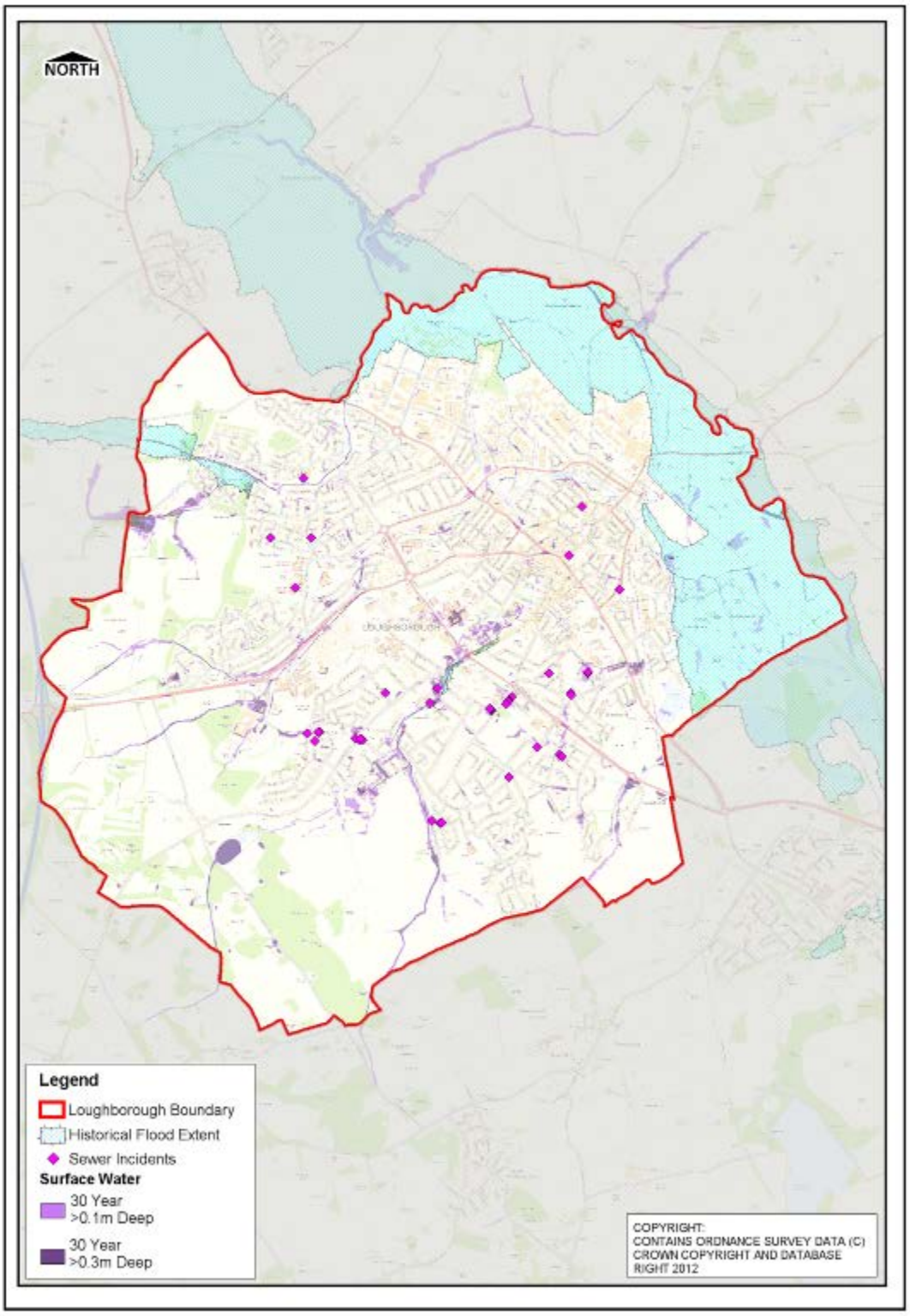


Figure 10-2: Historical Flooding in Loughborough plotted with the 1 in 30 year event

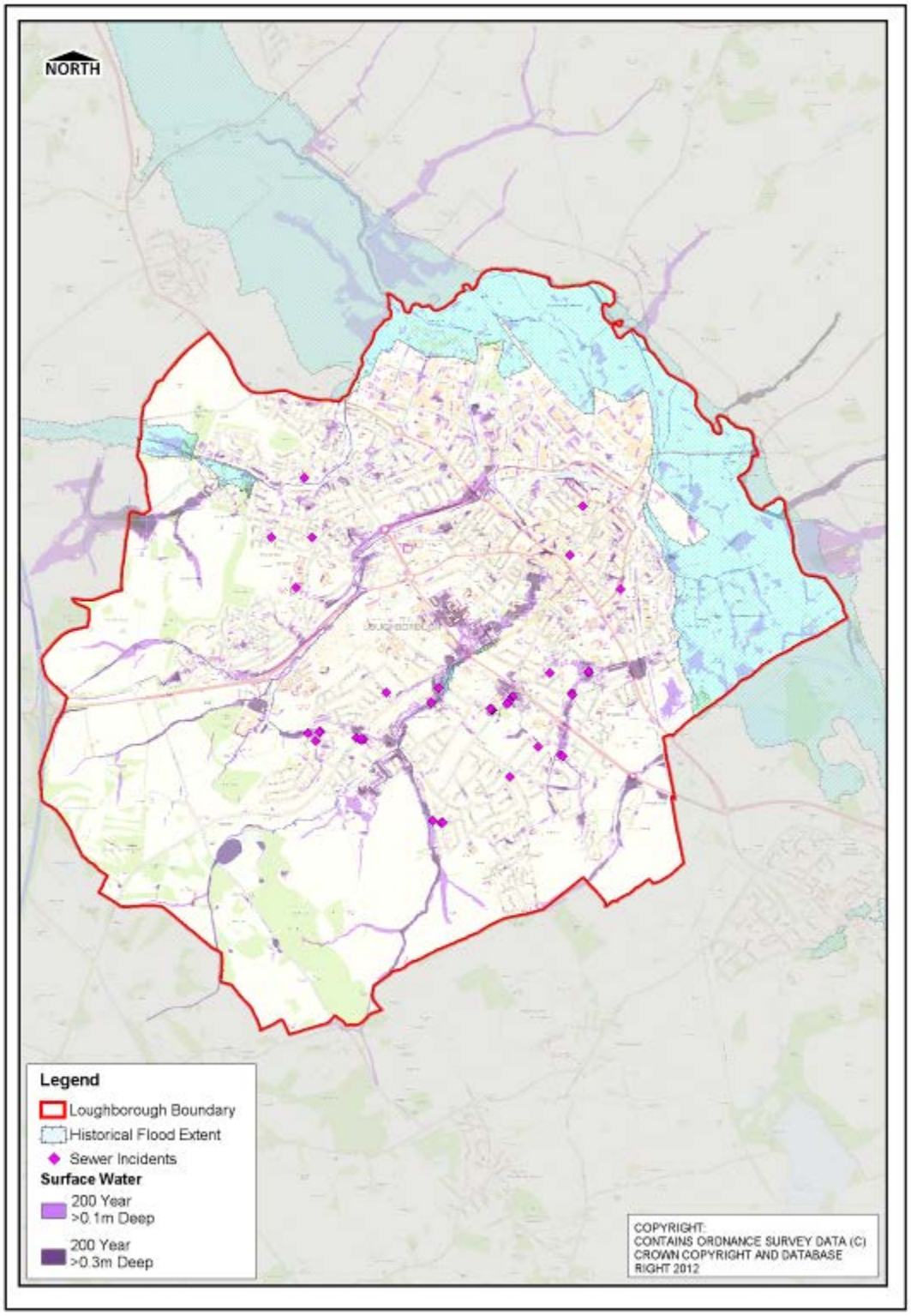


Figure 10-3: Historical Flooding in Loughborough plotted with the 1 in 200 year event

11 SEWER FLOODING

11.1 Overview

During heavy rainfall, flooding from sewer systems may occur if:

- The rainfall event exceeds the capacity of the sewer system / drainage system;
- The system becomes blocked by debris or sediment;
- The system surcharges due to high water levels in rivers.

11.2 Responsibility

In order to clearly identify problems and solutions, it is important to first outline the responsibilities of different organisations with respect to drainage infrastructure. The responsible parties are primarily as follows:

- LCC (as the highways authority),
- Severn Trent.

As illustrated in Figure 11.1, LCC as the Highways Authority, are responsible for maintaining an effective highway drainage system including kerbs, road gullies and the pipes which connect the gullies to the trunk sewers and soakaways. The sewerage undertaker, i.e. ST, is responsible for maintaining the trunk sewers.

Design standards for surface water sewers currently require the sewer design to be for a 1 in 30 year storm event. However, some existing sewers are likely to have lower capacity due to their age. Therefore, rainfall events with a return period frequency greater than 1 in 30 years would be expected to result in surcharging of some of the sewer system.

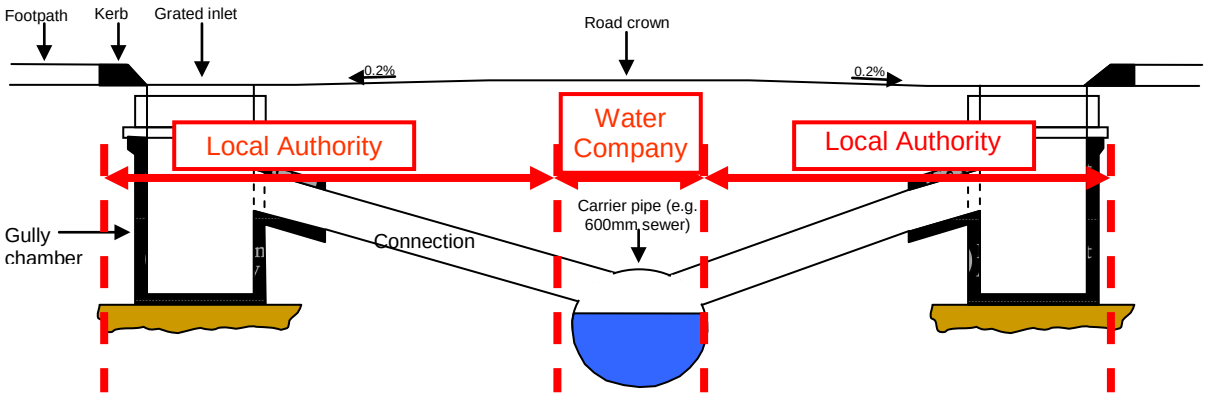


Figure 11-1: Surface Water Drainage Responsibility

11.3 Sewer Flooding Data Review

Sewer flooding was identified within Loughborough during the Charnwood SFRA using DG5 data from ST.

This database details the total number of flood incidents that have affected properties both externally and internally over the last 10 years and are indicated in Figure 10-2 and Figure 10-3.

The DG5 records exported from the ST FLOODS2 dataset contains 69 entries (dated November 2010). Of the 69 entries, 26 are for the foul network alone, 7 for the surface water network and 36 for the combined surface and foul network. Out of all 69 entries, 13 occur more than once.

In direct relation to the thirteen (multiple) entries for the surface water network, or combined network, ten entries are noted to have affected residential properties and one as having affected highways. Locations of these thirteen entries are mapped in Figure 11-2. As some of these entries are clustered, there are ultimately four key locations where there is documented information of multiple (event) surface water network or combined network flooding.

The majority of these 13 incidents which occur more than once, are located along Beacon Road. ST has confirmed that sewer upgrades are to take place within this area as well as along Holt Drive and Gavedon Green which are located within the vicinity.

During winter, snow melt is causing high river levels which in turn is causing back up in the sewers along Bottleacre Lane. ST are currently investigating the possibility of upgrading these sewers. They are also assessing the feasibility of a major rehabilitation of the entire sewer network within Loughborough.

DG5 Definition

ST maintain a register of properties which have suffered flooding from public sewers in order to fulfil statutory commitments set by OFWAT (the DG5 Register). The register includes incidents of both internal property flooding together with flooding to curtilages, highway and other open areas (external flooding), but only flooding due to hydraulic deficiencies are recorded on the DG5 register. Sewer flooding due to blockages is not recorded on the DG5 register. Properties flooded in severe weather (rare events) are recorded but OFWAT do not require these to go onto the DG5 register. It is also important to note that the DG5 register is not a full record of properties that have experienced sewer flooding in the past, since on completion of a flood alleviation scheme, properties are removed from the register.

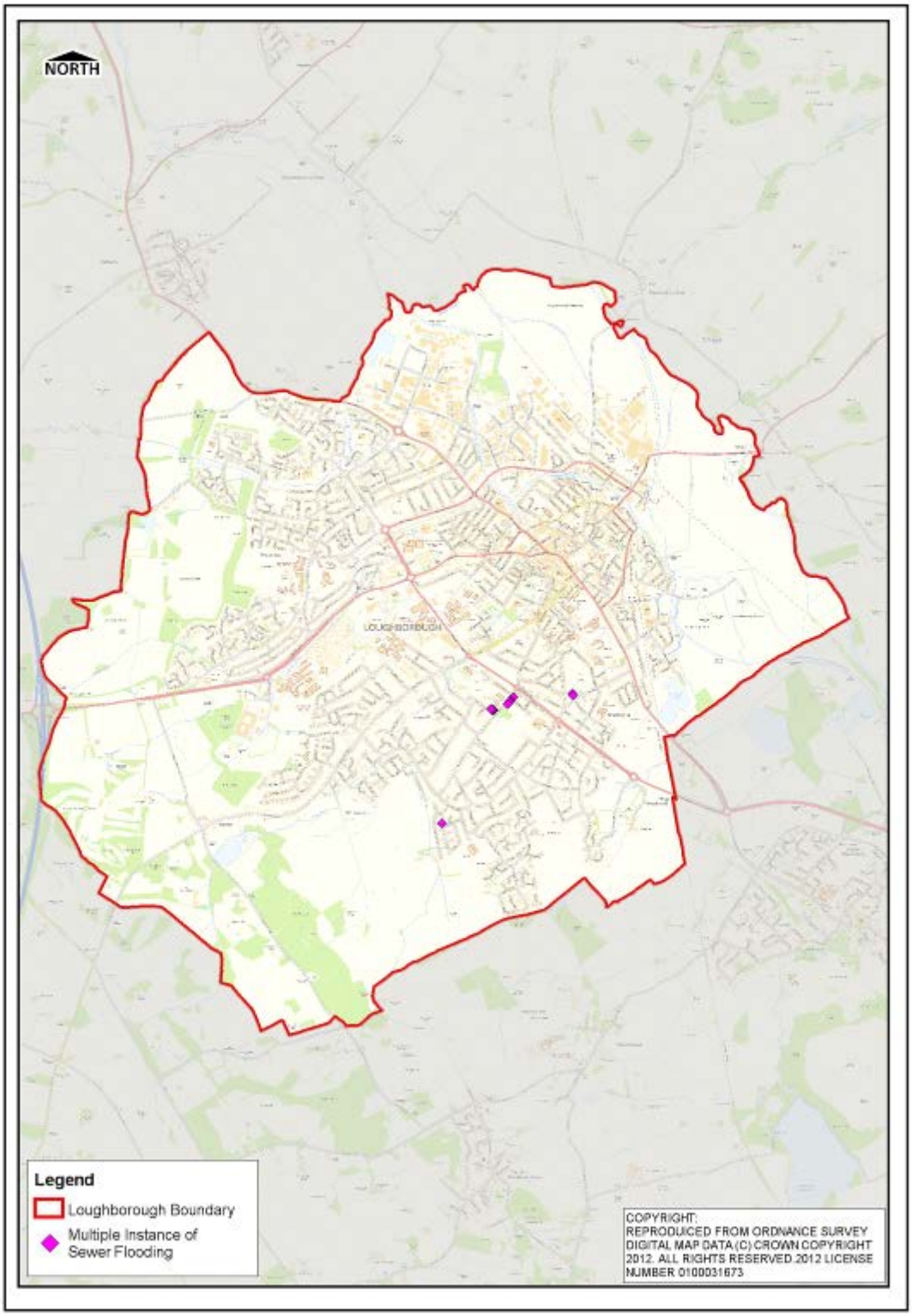


Figure 11-2: Records of Multiple Instances of Sewer Flooding

12 SMALL OPEN-CHANNEL AND CULVERTED WATERCOURSES

12.1 Overview

SWMPs consider the risk of flooding from small open channels and culverted watercourses in the study area. These channels and watercourses receive the majority of their flow from inside the urban area and perform an urban drainage function.

12.2 Watercourse Data Review

12.2.1 Main Rivers

The EA has responsibility over flooding from designated Main Rivers and flooding from this source has been further assessed and considered as part of the previously completed PFRA for Leicestershire and the SFRA for Charnwood.

According to the SFRA, the River Soar and Black Brook are both classified as the main rivers. This study has included the Black Brook within the assessment, however; the River Soar has not been included due to its location along the site boundary.

This study has not assessed the effects of Main River flooding as part of this study.

12.2.2 Ordinary Watercourses

As part of this study, no information has been provided by LCC regarding ordinary watercourses in the study area. According to the SFRA, the Burleigh Brook (including the Shortcliffe Brook) and the Wood Brook are watercourses considered as both main rivers and ordinary watercourses, therefore responsibilities lie with both the EA and LCC.

According to the 1:10,000 scale Ordnance Survey (OS) mapping, other watercourses (Summerpool Brook, Hermitage Brook, Grammar School Brook and the Oxley Gutter) are located within the study area. Mapping also indicated that sections of some watercourses are culverted within the urbanised areas.

Rivers within Loughborough have been presented in Figure 12-1. It should be noted that some rivers are classified as both ordinary watercourse and main rivers (e.g. Burleigh Brook and Wood Brook). These rivers are labelled as 'Ordinary Watercourses' within the figures.

12.2.3 Culverted Watercourses

Significant sections of the watercourses flowing through urban areas of Loughborough are culverted. However, detailed information regarding culvert dimensions and location is limited.

Using the (GIS) information, OS mapping and ST data, the presence of culverted watercourses across Loughborough have been investigated. This investigation indicates that sections of the Wood Brook have been culverted and sections of Burleigh Brook and Wood Brook also enter culverts as they flow under the GUC.

EA main river records, coupled with the studying of historical maps, show that there are one, two or possibly even three sections of watercourses that are culverted within the Willow Brook catchment area, one of which runs parallel with the GUC.

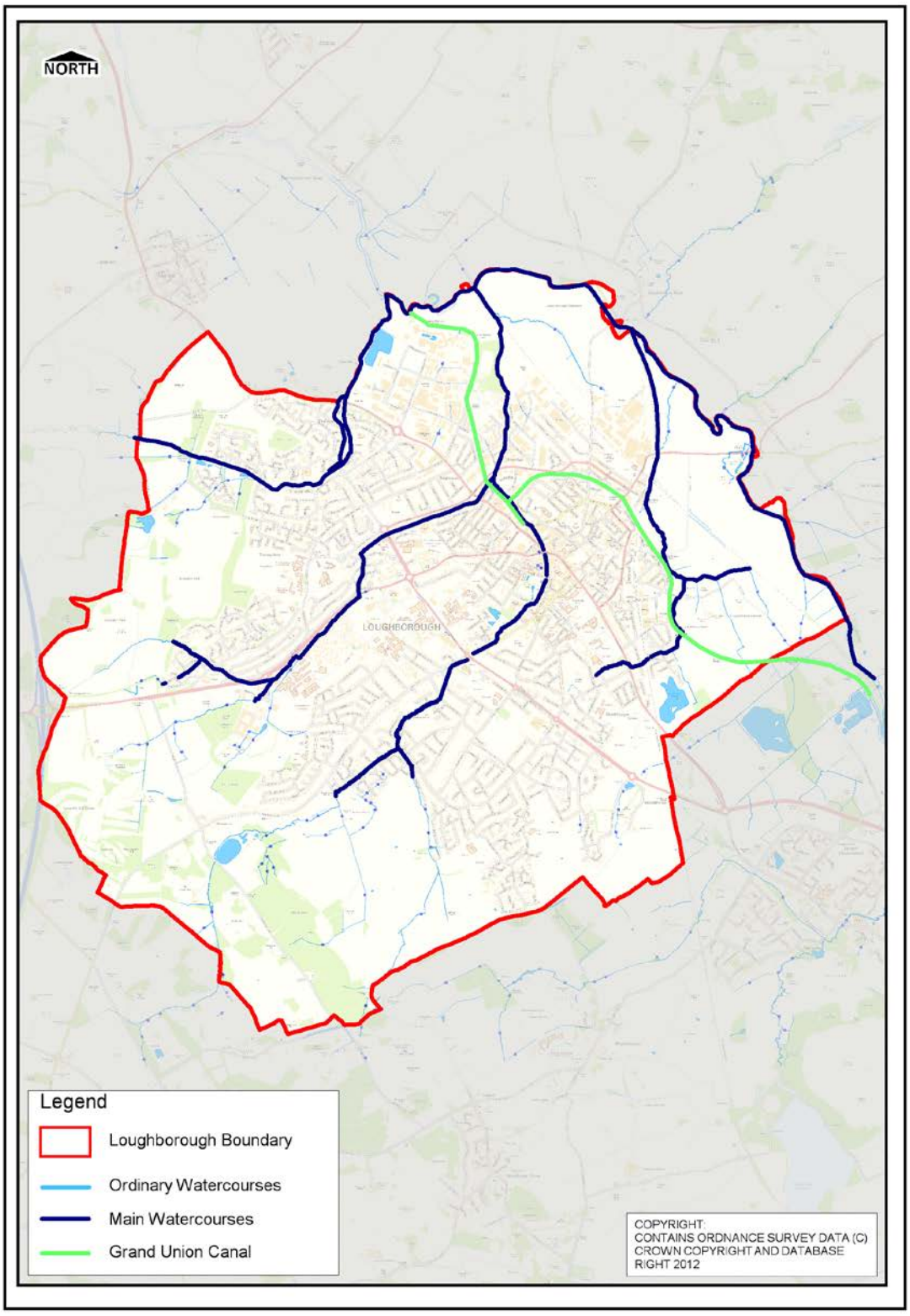


Figure 12-1: Watercourses in Loughborough

13 GROUNDWATER ASSESSMENT

13.1 Overview

Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from springs. This tends to occur after long periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is more likely to be at shallow depth. Groundwater flooding is known to occur in areas underlain by major aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels.

Groundwater flooding tends to occur sporadically in both location and time, and because of the more gradual movement and drainage of water, tends to last longer than fluvial, pluvial or sewer flooding. When groundwater flooding occurs, basements and tunnels can flood, buried services may be damaged, and storm sewers may become ineffective, exacerbating the risk of surface water flooding. Groundwater flooding can also lead to the inundation of farmland, roads, commercial, residential and amenity areas.

It is also important to consider the impact of groundwater level conditions on other types of flooding e.g. fluvial, pluvial and sewer. High groundwater level conditions may not lead to widespread groundwater flooding. However, they have the potential to exacerbate the risk of pluvial and fluvial flooding by reducing rainfall infiltration capacity, and to increase the risk of sewer flooding through sewer / groundwater interactions.

The need to improve the management of groundwater flood risk in the UK was identified through Defra's Making Space for Water strategy. The review of the July 2007 floods undertaken by Sir Michael Pitt highlighted that at the time no organisation had responsibility for groundwater flooding. The FWMA identified new statutory responsibilities for managing groundwater flood risk, in addition to other sources of flooding and has a significant component which addresses groundwater flooding.

LCC as a LLFA, has responsibility for addressing groundwater flooding risk locally, including assessing where risks are significant, and mapping the risk as part of the development of local flood risk management plans. The EA has a strategic role in groundwater flood management, and has a duty to support LCC. The EA is also responsible for flood warning, so where it is identified that there is a requirement for groundwater flood warning, the EA will take the lead.

As part of this commission, URS has undertaken an detailed assessment of Groundwater Flood Susceptibility for Loughborough (Appendix A), the conclusions and recommendations of which are summarised below.

13.2 Conclusions of Groundwater Flooding Susceptibility Assessment

- The Superficial geology underlying the north-eastern half of the study area comprises the Alluvium and Soar Valley Formation (sand and gravel). Both are classified by the EA as Secondary (A) aquifers and are therefore a potential source of groundwater flooding, if groundwater levels are near or at the surface;
- The bedrock geology across the study area comprises the Mercia Mudstone Group. The sand lenses present (Arden Sandstone Formation, Edwalton Member, Gunthorpe Member and Tarporley Siltstone Formation) are classified as secondary (A) aquifers. There is potential for a perched water table to develop within the sandstone and therefore potential for groundwater flooding if the water table is near or at the surface;

- Groundwater level monitoring data have been provided by the EA for the Alluvium Secondary (A) aquifer. These indicate that groundwater levels are at a shallow depth below ground level;
- There is no groundwater level monitoring data available for the bedrock deposits;
- Flood events data have been collated by the EA and provided as a Historic Flood map. Unfortunately the type of flooding is not identified, although the map lies over the areas where Alluvium, Soar Valley Formation and Head deposits are found, indicating that groundwater may have contributed;
- Areas susceptible to groundwater flooding have been identified using the BGS groundwater flooding susceptibility dataset. The data indicate a 'high' or 'very high' susceptibility to groundwater flooding in the areas of Alluvium, Soar Valley Formation, Head deposits and sandstone beds of the Mercia Mudstone Group;
- In recent times, the installation of sustainable drainage systems (SuDS) has been encouraged for new and existing developments with the aim of reducing overall flood risk. The BGS infiltration SuDS suitability dataset indicates that the areas 'Highly compatible for Infiltration SuDS' and 'Probably compatible for Infiltration SuDS' are located in small areas in the southern half of Loughborough Town. Most of the area will require enhanced site investigation and assessment prior to establishing suitability for high infiltration rate SuDS. The areas with Alluvium, Soar Valley Formation and Head deposits along the River Soar and its tributaries are unlikely to be suitable for SuDS.

It should be noted that whilst indicative for infiltration SuDS, other forms of SuDS (e.g. attenuation based) are available and could be more suitable in certain areas.

13.3 Recommendations from Groundwater Flooding Susceptibility Assessment

- Information on foul sewer leakage should be obtained, if available, to help further delineate the areas with the potential for groundwater flooding;
- The areas identified as being susceptible to groundwater flooding should be compared with those areas identified as being susceptible to other sources of flooding e.g. fluvial and pluvial. An integrated understanding of flood risk will be gained through this exercise;
- The impact of infiltration SuDS on water quality and quantity with respect to the Water Framework Directive (WFD) should be considered further within future investigations including those undertaken by developers;
- Monitoring boreholes which are installed by developers or the council should be regularly manual dipped and water levels accurately recorded using automatic level recording equipment to one or two decimal places. Also consideration should be given to installing a monitoring borehole in the sandstone beds of the Mercia Mudstone Group (Arden Sandstone Formation, Edwalton Member, Gunthorpe Member and Tarporley Siltstone Formation), to help understand the groundwater response within these formations and members during periods of flooding;
- Data identifying properties with basements/cellars should be used to improve the understanding of susceptibility to groundwater flooding at these properties.

14 CRITICAL DRAINAGE AREAS

14.1 Overview

Loughborough was divided into four hydrological catchments using data from the Flood Estimation Handbook (FEH) CD-ROM. Due to the extensive nature of these catchments, four site-specific hotspots/Critical Drainage Areas (CDAs) were identified for assessment. Two CDAs (Willow Brook and Grammar School Brook) were assessed within the recent Loughborough IUD study; therefore information from these CDAs has been incorporated into the SWMP. The remaining two hotspots, (Wood Brook and Burleigh Brook), were identified using the FMfSW outputs for the 1 in 30 year event and the 1 in 200 year event.

The spatial distributions of the four flooding hotspots/CDAs are shown in Figure 14-1. LCC are the 'lead' authority in terms of managing flood risk within these identified CDAs though it may be necessary to work with other stakeholders (i.e. CBC, the EA and ST) to manage flood risk within several of the CDAs.

Within the SWMP community, there is a 'working definition' of a CDA as a:

> *"discrete geographic area (usually within an urban setting) where there may be multiple and interlinked sources of flood risk and where severe weather is known to cause flooding of these areas thereby affecting people, property or local infrastructure".*

The remainder of this chapter provides a description of each CDA including details of the flooding mechanisms and interaction between flooding locations within the CDA, the level of validation, any specific assumptions made, and the number and types of receptors identified to be at risk.

14.2 Property Counts

The FMfSW has been used to inform an improved understanding of the level of flood risk facing both LCC and CBC. In order to identify the CDAs and to provide a quantified indication of potential risks, property counts for the 1 in 30 year and 1 in 200 year rainfall events have been undertaken. The property counts for both scenarios are shown in Table 14-1.

These counts have been undertaken using the EA National Receptors Dataset (NRD) and follows the methodology used successfully by URS on a number of other SWMPs.

14.3 Risk to Existing Residential Properties

To support the assessments of flooding at the identified hotspots and across the associated CDAs, and in order to build a better understanding of flood risk, site specific images containing surface water data, are included in the summaries below.

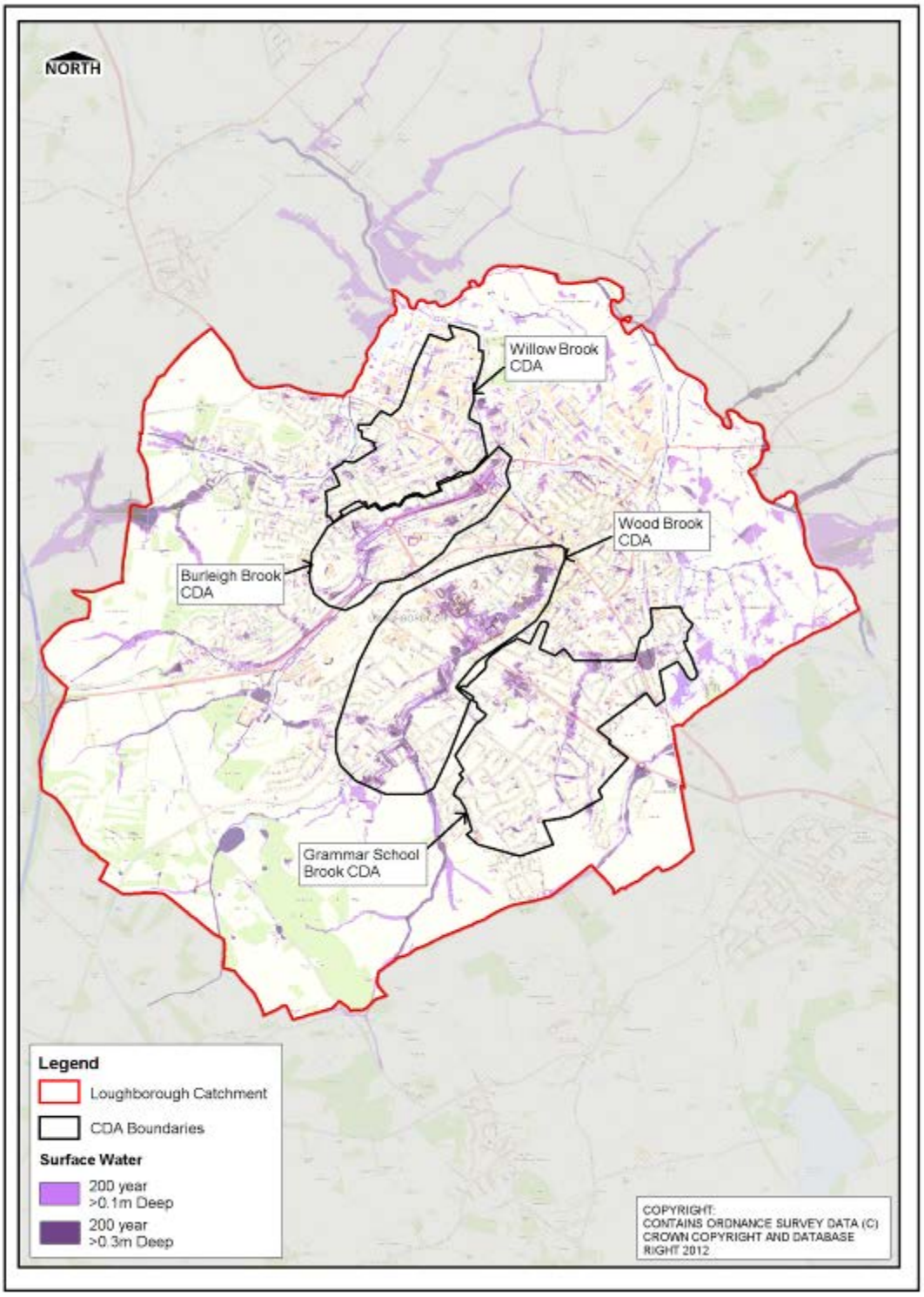


Figure 14-1: Location of CDAs with 1 in 200 Year Event

TABLE 14.1: PLUVIAL MODELLING PROPERTY COUNT									
Prioritised Areas	Area (km^2)	Dwellings (1 in 30 Year Event)			Dwellings (1 in 200 Year Event)			Fluvial Flood Zone	Recorded Flood Incidents
		Shallow (<300mm)	Deep (>300mm)	Total	Shallow (<300mm)	Deep (>300mm)	Total		
Willow Brook	1.2	15	1	16	186	15	201	YES	YES
Grammar School Brook	2.4	125	36	153	313	160	473	NO	YES
Wood Brook	2.3	157	60	217	314	277	591	YES	YES
Burleigh Brook	1.1	40	17	57	275	71	346	YES	NO[7]

[7] Data provided by the EA and LCC shows no historical flooding within the Alan Moss area. However, recent events (June 2012) have shown significant surface water flooding within this area.

14.4 CDA1 – Willow Brook

The Willow Brook catchment is situated in the north of Loughborough (Figure 14-2). It is bounded by the GUC to the north and east, Knighthorpe Road to the south, Thorpe Acre Road to the south west and Warwick Way, Bishop Meadow Road and Soarbank Way to the west. The catchment outfall discharges into the Grand Union Canal in the grounds of the Astrazeneca site. This is via a culverted watercourse in the north of the catchment.

The catchment can be clearly split into two areas – the upper catchment, lying to the south west, being made up of primarily residential properties and the lower catchment, lying to the north, being heavily industrial and 100% paved. According to the initial assessment several culverted watercourses exist within the Willow Brook catchment, the majority located in the lower catchment.

Analysis of the FMfSW indicates there is a potential risk of pluvial flooding from the Willow Brook. A total of 16 properties and 201 properties have been identified as being potentially at risk of flooding during the modelled 1 in 30 year and 1 in 200 year events respectively.

As discussed in Section 14.1, the Willow Brook catchment formed part of the Loughborough IUD study. The IUD study indicates that flooding occurs in upper residential catchment areas due to a lack of capacity in the upstream pipes. The tendency for home owners to pave over front gardens is thought to exacerbate the issue by increasing run-off to the drainage system.

The IUD study also suggests significant flooding in the lower industrial catchment area. However, a number of assumptions, including dimensions of the main culverted watercourse, have been made in the modelling in this area. Therefore, model results are considered less reliable in the lower industrial catchment area.

As can be seen in Figure 14-2 which shows areas affected during the 1 in 200 year event, the main areas to be affected are those located just off Kings Avenue and Milton Street. In relation to Milton Street a large cluster can be identified due to the location of the Palma Park caravan site.

Figure 14-2: Willow Brook CDA (1 in 200 Year Event)

14.5 CDA2 – Grammar School Brook

The Grammar School Brook catchment is situated in the south east of Loughborough. Topography within the catchment generally rises in a south westerly direction. The catchment comprises mainly suburban residential development that has separate foul and surface water networks.

Surface water runoff is conveyed in conventional surface water sewerage networks to three main and several subsidiary outfalls into the Grammar School Brook. Grammar School Brook then flows in a north easterly direction to an inverted siphon beneath the GUC.

Modelling has shown that there is a risk of pluvial flooding in the Grammar School Brook area (Figure 14-3). A total of 153 properties and 473 properties have been identified as being potentially at risk of flooding during the modelled 1 in 30 year and 1 in 200 year events respectively.

As discussed in Section 14.1, the Grammar School Brook catchment formed part of the Loughborough IUD study. The IUD study indicates that the main issue within this catchment is that the surface water sewer networks are generally under-capacity with the paving over of front gardens and highway verges exacerbating the issue.

SuDS features (mainly attenuation with controlled releases), have been implemented as part of new developments, however records of SuDs features (e.g. location and type) are poorly recorded.

The IUD study focuses on several flooding hot spot areas including Holt Drive, Beacon Road, Beaumont Road, Castledine Street and the Territorial Army Centre. Interventions that may provide “quick win” results have been identified at these locations and are summarised in Phase III of the report.

Figure 14-3: Grammar School Brook CDA (1 in 200 Year Event)

14.6 CDA3 – Wood Brook

The Wood Brook catchment is situated in the centre of Loughborough located north of the Grammar School Brook catchment. This was one of the CDAs chosen for assessment based on pluvial modelling outputs (Figure 14-4).

The FMfSW illustrates that there is a significant risk of pluvial flooding within the catchment. A total of 217 properties and 591 properties have been identified as being potentially at risk of flooding during the 1 in 30 year and 1 in 200 year events respectively. Within the upstream area of the catchment, several sewer flooding incidents can also be identified.

The majority of the flooding within the area is associated with Wood Brook which flows through the centre of the CDA. Upstream a large cluster of affected properties can be identified within the vicinity of Brook Lane and Priory Road whilst properties near Loughborough University on Kingfisher Way are also significantly affected during the 1 in 200 year event (Figure 14-4).

Figure 14-4: Wood Brook CDA (1 in 200 Year Event)

14.7 CDA4 – Burleigh Brook

The Burleigh Brook CDA is also situated in the centre of Loughborough located immediately south of the Willow Brook CDA and north of the Wood Brook CDA (Figure 14-5).

The FMfSW illustrates that there is a significant risk of pluvial flooding within the catchment. A total of 57 properties and 346 properties have been identified as being potentially at risk of flooding during the 1 in 30 year and 1 in 200 year events respectively.

It is assumed that the majority of the flooding within this catchment is connected to Burleigh Brook which flows through the centre of the CDA. The majority of the properties affected during the 1 in 200 year event are located along both sides of Alan Moss Road with another small cluster within the vicinity of Blackbrook Lane further upstream.

Although no historical records of flooding have been provided for this area, there was significant surface water flooding within the CDA in June 2012. According to local sources such as ITV and the Loughborough Echo, the worst affected areas were along Derby Road and Alan Moss Road.

Figure 14-5: Burleigh Brook CDA (1 in 200 Year Event)

14.8 Risk to Future Development

Due regard has been given to potential future development. Significant housing/employment development and associated infrastructure (e.g. sewers, roads etc) are unlikely within the CDAs over the Core Strategy timeframe (approximately 15 years).

However, as introduced in Section 5.1, the Core Strategy Supplementary Consultation document (June 2013) considers three general areas of land adjoining Loughborough for future growth. Future development in these areas has the potential to increase surface water flood risk in existing urban areas, primarily as a direct consequence of increased runoff.

The three general areas being considered for future growth are described below and identified in Figure 14-6.

- Option 1 – Sustainable Urban Extension West of Loughborough;
- Option 4 – Growth adjoining Shepshed;
- Option 5 – Expansion of the Science and Enterprise Park;

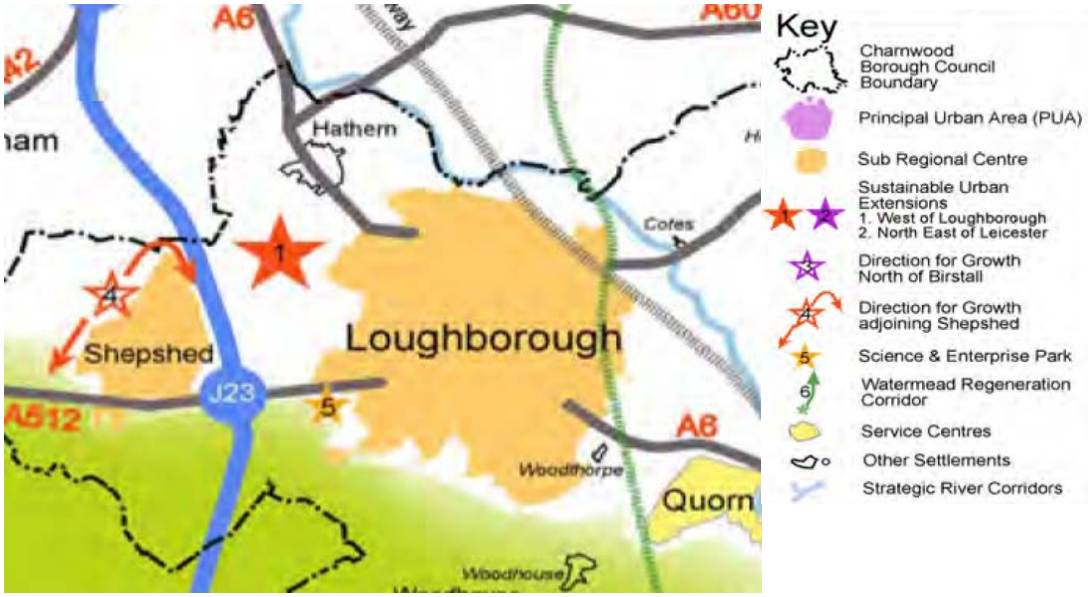


Figure 14-6: Direction for Growth Options (Core Strategy Supplementary Consultation document (June 2013))

National Planning Policy identifies that new development should not increase risk to existing developments and where practicable, provide betterment. A review of the location and the potential for future development to either impact or be impacted on has been undertaken in the sub-sections below. This review will aid the development of policies to reduce the impact of surface water flooding and provide benefits through links with other policies and plans.

14.8.1 Option 1

Option 1 involves a sustainable urban extension to the west of Loughborough (north of the A512) of approximately 3,000 homes and up to 16 ha of employment land. This will lead to the restoration of Garendon Historic Park and provide public access. Given the number of additional residential dwellings and employment land proposed for this growth area, it is

important that the risk of increased surface water runoff and potential for flooding is fully considered during the planning stages.

Figure 14-7 identifies flow pathways and areas affected by surface water flooding within Option 1 during the 1 in 200 year event. Proposed development should accommodate such areas within the Masterplanning process and provide open space, for example by setting development back from these features or retaining a corridor within the locality.

Due to the scale of the development, an FRA will be required as part of the planning process for each planning application. The FRA should focus on surface water management issues to ensure no increased flood risk is experienced by third parties downstream or within new development associated with the potential growth area.

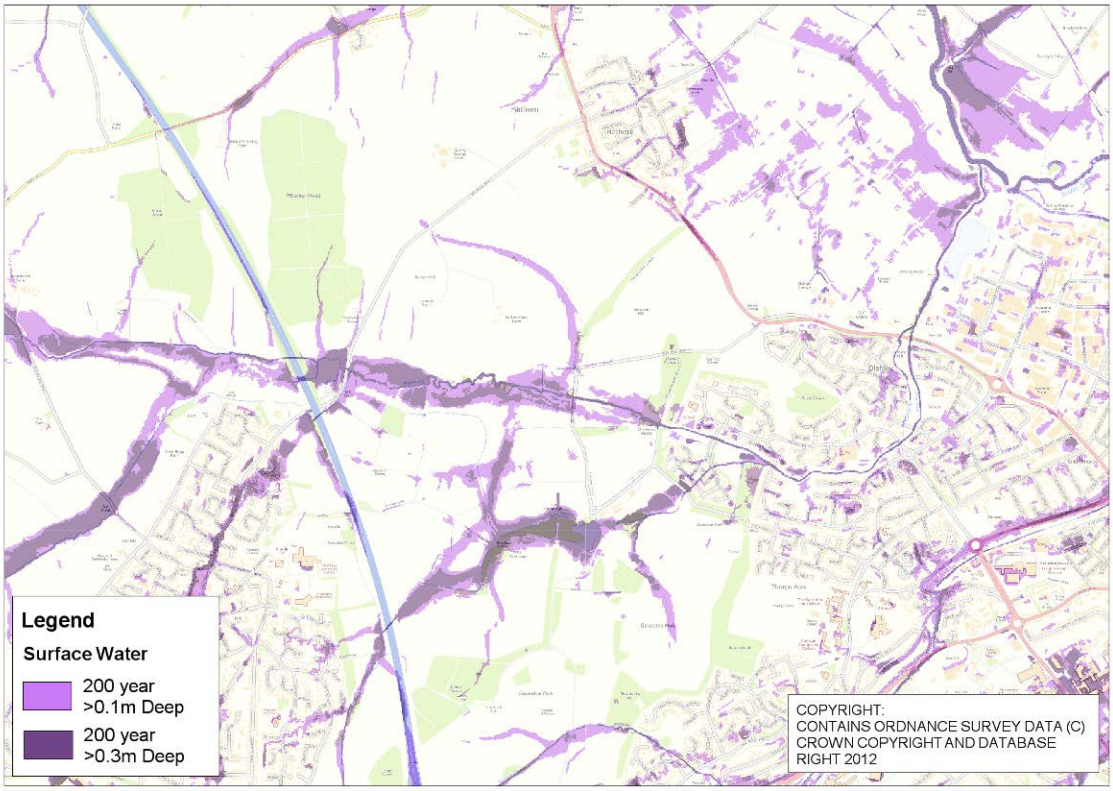


Figure 14-7: Option 1 with 1 in 200 year event

14.8.2 Option 4

Closely related to the western growth area of Loughborough (Option 1) is the direction of growth at Shepshed (Figure 14-6, Option 4). It is assumed that 500 homes will be developed to support the regeneration strategy. As above, it is important that the risk of increased surface water runoff and potential for flooding is fully considered during the planning stages

Figure 14-8 identifies flow pathways and areas affected by surface water flooding within Option 4 during the 1 in 200 year event. Proposed development should accommodate such areas within the Masterplanning process and provide open space, for example by setting development back from these features or retaining a corridor within the locality.

Due to the scale of the development, an FRA will be required as part of the planning process for each planning application. This should address surface water runoff issues and ensure no increase risk to existing developments within the Shepshed area.

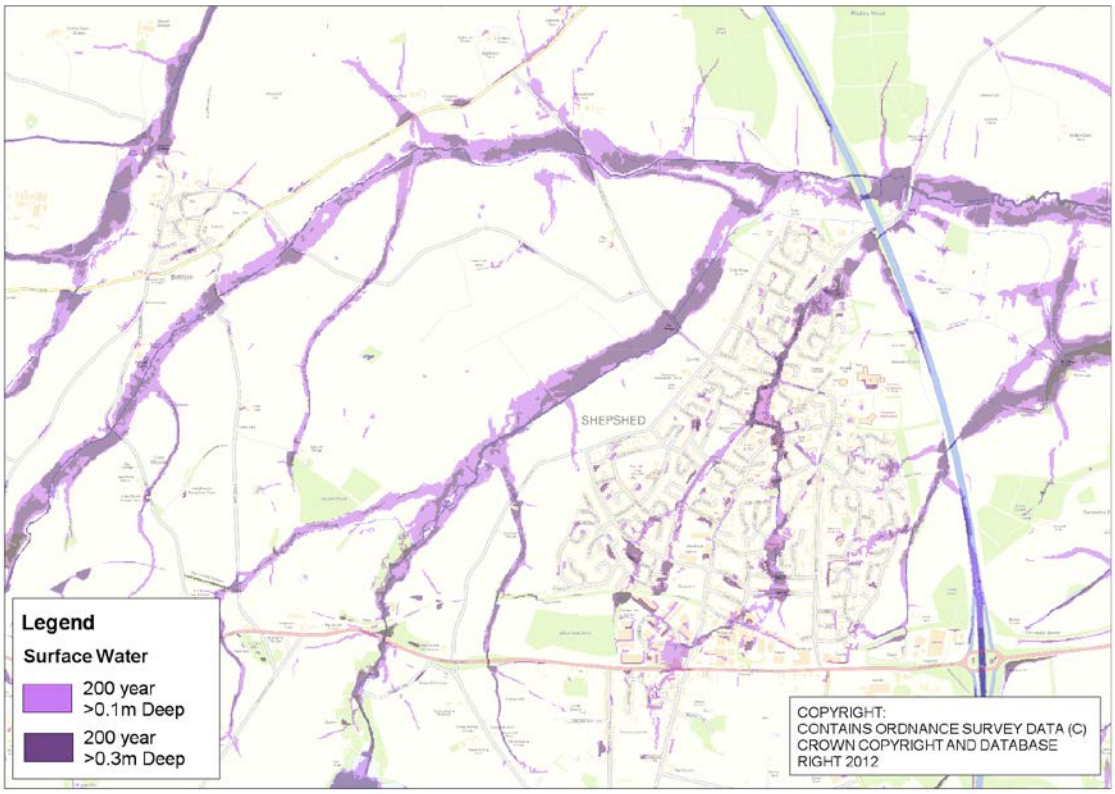


Figure 14-8: Option 4 with 1 in 200 year event

14.8.3 Option 5

An extension of the Science and Enterprise Park, located to the south-west of Loughborough (below the A512), will deliver 77 hectares of high technology land in a campus environment. Given the extensive area that is being developed, it is important that the risk of increased surface water runoff and potential for flooding is fully considered during the planning stages.

Figure 14-9 identifies flow pathways and areas affected by surface water flooding within Option 5 during the 1 in 200 year event. Proposed development should accommodate such areas within the Masterplanning process and provide open space, for example by setting development back from these features or retaining a corridor within the locality. An FRA will be required to address potential flood risk to and from the proposed development.

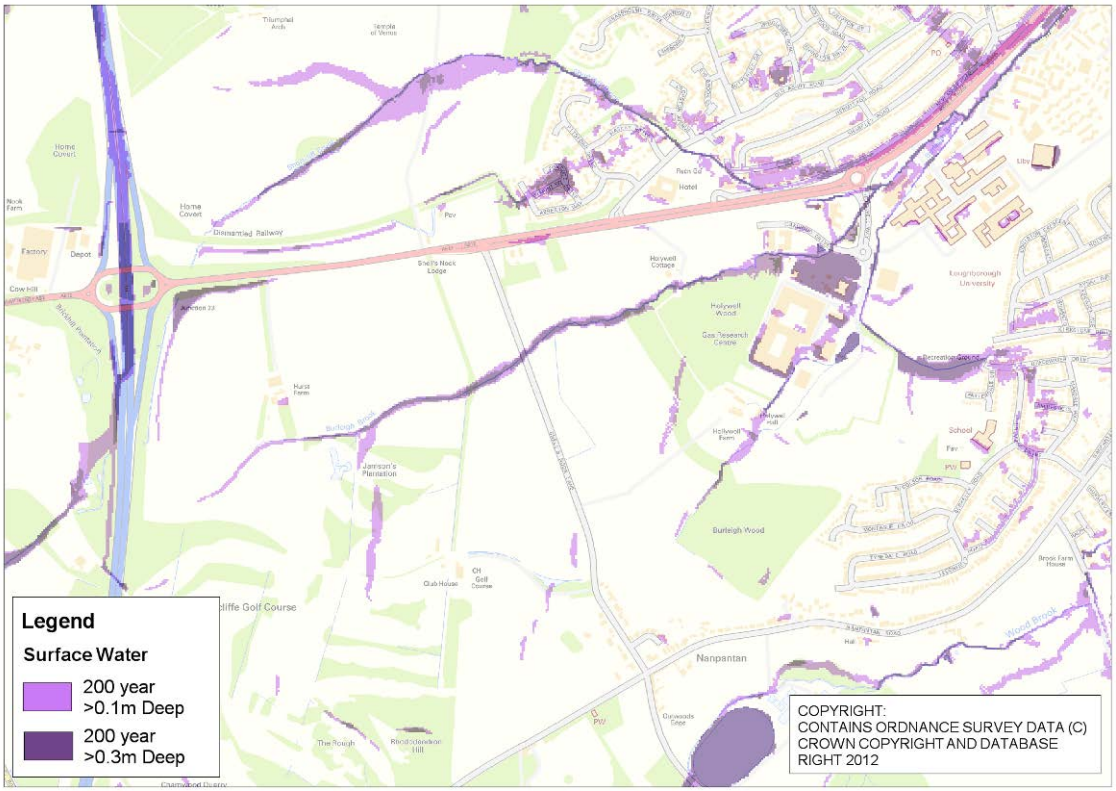


Figure 14-9: Option 5 with 1 in 200 year event

In addition to these major developments, it is expected that approximately 3,500 homes and up to 6 hectares of employment land will be developed on smaller sites within and adjoining, Loughborough and Shepshed. It is important that flood risk, especially from surface water, is considered during the planning stage of these developments. It should also be noted that there are plans to develop the town centres of both Loughborough and Shepshed to help complement the regeneration strategies.

14.8.4 Additional Considerations

For the above development areas it is also essential that the impact of future development on existing infrastructure, including the drainage systems, is assessed as part of the planning process (on a development by development basis) and that this is adequately managed by CBC in consultation with LCC, ST and the EA where applicable.

14.9 Communicate Risk

14.9.1 Professional Stakeholders

There are various professional stakeholders interested in increasing their knowledge of risks from surface water flooding. It is important that the FRMB actively engages with these groups, where appropriate, to share the findings of this report. This will ensure that emerging plans and policies are informed by the most up-to-date available understanding of surface water flood risk issues.

It is recommended that LCC consider making the SWMP outputs available on their website (and also CBCs website) for professional stakeholders and members of the public to access and view.

14.9.2 Local Resilience Forums

In line with the SWMP Technical Guidance it is strongly recommended that the information provided in the Phase II SWMP is issued to LRFs. Surface water flood maps and knowledge of historic flood events should be used to continuously update Incident Management Plans and Community Risk Registers for the area. In addition, maps showing the depth of pluvial flooding during a range of return period rainfall events can be used to inform operations undertaken by emergency response teams especially near public buildings and major routes throughout Loughborough.

14.9.3 Communication and Engagement Plan

It is recommended that a Communication and Engagement Plan should be produced for Loughborough to effectively communicate and raise awareness of surface water flood risk to different audiences using a clearly defined process for internal and external communication with stakeholders and the public.

Local Government Group guidance highlights the following issues when considering preparation of a Communication Plan:

- Ensuring communities have enough information to increase their own resilience;
- Addressing past floods and managing future risks, thus adapting to climate change;
- Optimising existing communication activities being delivered by partners; potential for joint working;
- Making sure that all audiences have a clear understanding of the key messages, how to access the right information, and how communities can take the necessary precautions before, during and after flood events.

In light of these recommendations, the Communication Plan should:

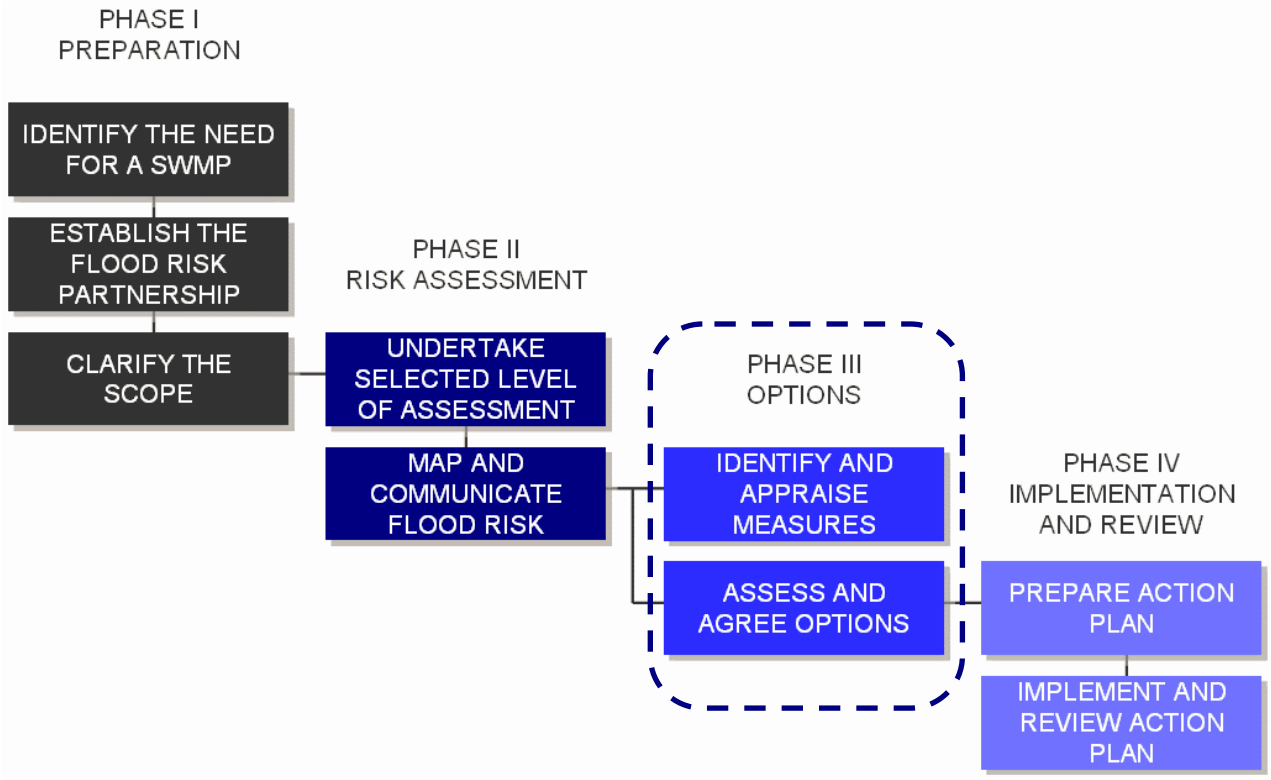
- Develop clear key messages from the SWMP (and PFRA) relating to local surface water flood risk and management;
- Create simplified maps and meaningful data for communications materials;
- Clearly define a structure for multi-agency partnership working (based on the partnership structure identified in Phase I of the SWMP) and formalise through Terms of Reference;
- Provide a strategy for communicating the SWMP findings to political stakeholders, LRF members, Regional Flood and Coastal Committee (RFCC) members and the general public, and engaging these parties in future local flood risk management actions.

Recommendation: Actively engage with professional stakeholders to communicate findings of SWMP and local flood risk management.

Recommendation: Issue the SWMP to LRFs and use the SWMP to inform emergency response operations and update Incident Management Plans and Community Risk Registers.

Recommendation: Design and gain buy-in to a Communication and Engagement Plan to identify how to effectively communicate and raise awareness of local flood risk to different audiences.

PHASE III: OPTIONS



15 PHASE III: OPTIONS

15.1 Objectives

The purpose of Phase III is to identify potential structural and non-structural measures for alleviating flood risk and to assess the full range of options available, eliminating those that are not feasible or cost beneficial. The remaining options are then developed and tested against their relative effectiveness, benefits and costs.

To maintain continuity within the report and to reflect the flooding mechanisms within Loughborough the option identification has taken place on an area-by-area (site-by-site) basis following the process established in Phase II. Therefore, the options assessment undertaken as part of the SWMP assesses and short-lists the measures for each CDA and identifies any non-standard measures available.

Phase III reports a high level option assessment for each of the CDAs identified in Phase II. No monetised damages have been calculated and flood mitigation costs have been determined using engineering judgement, but have not undergone detailed analysis. Costs should be treated at an order of magnitude level of accuracy. The options assessment presented here follows the methodology described in the SWMP Technical Guidance but is focussed on highlighting areas for further detailed analysis and immediate 'quick win' actions.

15.2 Methodology

15.2.1 Identify Measures

This stage aims to identify measures that have the potential to alleviate surface water flooding in Loughborough. It has been informed by the understanding of flood mechanisms developed in Phase I and Phase II. Where possible options have been identified that have multiple benefits, for example to alleviate flooding from more than one source, or provide environmental benefits such as to water quality, biodiversity and amenities. At this stage the option identification does not consider constraints such as funding or delivery mechanisms that would be required as part of any robust assessment.

A standard set of structural and non-structural measures have been specified for consideration within each CDA (Table 15-1) and follow the source-pathway-receptor model. Structural measures are considered to be those which require fixed or permanent assets to mitigate flood risks. Non-structural measures are those which are responses to urban flood risk that may not involve fixed or permanent facilities, and whose positive contribution to the reduction of flood risk is most likely through a process of influencing behaviour.

The identification of alleviation measures within CDA1 (Willow Brook) and CDA2 (Grammar School Brook has been informed by outputs from the IUD report. Additional measures for consideration are also proposed, which have been identified during the SWMP process.

TABLE 15-1: STANDARD STRUCTURAL AND NON-STRUCTURAL MEASURES FOR CONSIDERATION		
Source	**Pathway**	**Receptor**
Green Roof	Increasing capacity in drainage systems	Improved weather warning
Soakaways	Separation of foul and surface water sewers	Planning policies to influence development
Swales	Improved maintenance regimes	Temporary or demountable flood defences
Permeable Paving	Managing overland flows	Social change, education and awareness
Rainwater Harvesting	Land management practices	Improved resilience and resistance measures
Detention Basins	Making Space for Water	

An initial opportunity assessment has been undertaken for each CDA to evaluate where there were opportunities for the implementation of structural and non-structural measures. This initial appraisal enables feasible schemes to be targeted and a refined set of options to be analysed in more detail. The assessment criteria for the opportunity assessment are shown in Table 15-2, with the results from the opportunity assessment for each CDA shown in Table 15-3.

TABLE 15-2: MEASURES OPPORTUNITY ASSESSMENT CRITERIA	
✓	There are opportunities for implementation of this mitigation measure within the CDA. Measure should be considered in the Options Assessment.
✓	There may be some, albeit limited, opportunities for implementation of this mitigation measure within the CDA. Measures should be considered in the Options Assessment but would likely be limited in effectiveness or be subject to site-specific investigations prior to consideration.
×	There are no opportunities for implementation of measure within CDA. The measure is not suitable or required to address the surface water flood risk within the CDA.
	This particular measure is not applicable for this CDA.

TABLE 15-3: MEASURES OPPORTUNITY ASSESSMENT

Critical Drainage Area	Source							Pathway							Receptor				
	Green Roofs	Soakaways	Swales	Permeable Paving	Rainwater Harvesting Greywater Recycling	Detention Basins, Ponds and Wetlands	Other 'Source' Measures	Increasing Drainage System Capacity	Improved Maintenance Regimes	Managing Flow: Increasing Drainage System Capacity	Managing Flow: Improved Maintenance Regimes	Land Management Practices	De-culverting Watercourse(s)	Other 'Pathway' Measures	Planning Policies	Temporary/Demountable Defences	Education and Social Awareness	Improved Resilience and/or Resistance	Other 'Receptor' Measures
1 – Willow Brook	✓	×	×	✓	✓	✓		✓	✓	×	×	×	✓		✓	×	✓	✓	
2 – Grammar School Brook	×	✓	×	✓	✓	×		✓	✓	✓	✓	×	×		✓	×	✓	✓	
3 – Wood Brook	×	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	×		✓	×	✓	✓	
4 – Burleigh Brook	×	✓	×	✓	✓	✓		✓	✓	✓	✓	✓	×		✓	×	✓	✓	

TABLE 15-4: IDENTIFICATION OF POTENTIAL OPTIONS		
Description		**Standard Measures Considered**
Do Nothing	Make no intervention / maintenance.	• None
Do Minimum	Continue existing maintenance regime.	• None
Improved Maintenance	Improve existing maintenance regimes e.g. target improved maintenance to critical points in the system.	• Improved Maintenance Regimes
Planning Policy	Use development control policies to steer development away from areas of surface water flood risk or implement flood risk reduction/resilience measures.	• Planning Policies to Influence Development
Source Control, Attenuation and SUDS	Source control methods aimed at reducing the rate and volume of surface water runoff through infiltration or storage, and therefore reduce the impact on receiving drainage systems.	• Green Roof • Soakaways / Swales • Permeable paving • Rainwater harvesting • Detention Basins, Ponds and Wetlands • Land Management Practices
Flood Storage / Permeability	Large-scale SUDS that have the potential to control the volume of surface water runoff entering the urban area, typically making use of large areas of green space. Upstream flood storage areas can reduce flows along major overland flow paths by attenuating excess water upstream.	• Detention Basins • Ponds and Wetlands • Managing Overland Flows (Online Storage) • Land Management Practices
De-culvert / Increase Conveyance	De-culverting of watercourses and improving in-stream conveyance of water.	• De-culverting Watercourse(s)
Preferential / Designated Overland Flow Routes	Managing flow routes through urban environment to improve conveyance and routing water to watercourses or storage locations, e.g. creating play areas designed to flood.	• Managing Flows Routes (Preferential Flowpaths) • Temporary or Demountable Flood Defences
Community Resilience	Improve community resilience and resistance of existing and new buildings to reduce damages from flooding through predominantly non-structural measures.	• Improved Weather Warning • Temporary or Demountable Flood Defences • Social Change, Education and Awareness • Improved Resilience and Resistance Measures

TABLE 15-4: IDENTIFICATION OF POTENTIAL OPTIONS		
Description		**Standard Measures Considered**
Infrastructure Resilience	Improve resilience of critical infrastructure in the CDA that is likely to be impacted by surface water flooding, e.g. electricity substations, pump houses.	• Improved Resilience and Resistance Measures
Other - Improvement to Drainage Infrastructure	Add storage to, or increase the capacity of, underground sewers and drains and improve the efficiency or number of road gullies.	• Increasing Capacity in Drainage Systems
Other or Combination of Above	Alternative options that do not fit into above categories or combinations of the above options where it is considered that multiple options would be required.	

15.3 Identify and Shortlist Options

Following the identification of measures that should be considered within Loughborough, options have been identified and shortlisted for each CDA. As the focus at this stage is deliberately on the suitability of the potential options and not on a detailed appraisal of costs and benefits, a high-level scoring system for each of the options has been developed (which even at this stage does recognise the need for some consideration of economic viability). The approach to shortlisting the measures is based on the guidance in FCERM[8] and the SWMP Technical Guidance[9]. The scoring criteria are provided in Table 15-5.

TABLE 15-5: OPTIONS ASSESSMENT SHORTLISTING CRITERIA

Criteria	Description	Score
Technical	• Is it technically possible and buildable? • Will it be robust and reliable? • Would it require the development of a new technique for its implementation?	**U** Unacceptable (measure eliminated from further consideration) **-2** Severe negative outcome **-1** Moderate negative outcome **0** Neutral **+1** Moderate positive outcome **+2** High positive outcome
Economic	• Will benefits exceed costs? • Is the measure within available budget? • Estimate the whole life costs of the option including asset replacement, operation and maintenance. The scoring of this measure will depend on the budget available from the local authority although it should be remembered that alternative routes of funding could be available such as Midlands RFCC.	
Social	• Will the community benefit or suffer from implementation of the measure? • Does the option promote social cohesion or provide an improved access to recreation/open space? • Does option result in opposition from local communities for example if an option involves displacement of houses?	
Environmental	• Will the environment benefit or suffer from implementation of the measure? • Would the option have a positive or negative effect on the environment for example, water quality and biodiversity?	
Objectives	• Will it help to achieve the objectives of the SWMP partnership? • Does the option meet the overall objective of alleviating flood risk?	

[8] Environment Agency (March 2010) 'Flood and Coastal Erosion Flood Risk Management Appraisal Guidance', Environment Agency: Bristol.
[9] Defra (March 2010) 'Surface water management plan technical guidance', Defra: London

By conducting this process, inappropriate measures are eliminated in the early stages meaning that the investigations of options that are not acceptable to stakeholders are avoided. The shortlisted options have been identified that could be further explored to alleviate flooding and an initial indication of cost has been determined.

15.4 High Level Costs

A cost for the preferred flood mitigation option of each CDA has been estimated based on standard unit costs that were developed for the Drain London Tier 2 SWMPs (Table 15-5). No monetised damages have been calculated, and flood mitigation costs have been determined using engineering judgement but have not undergone detailed analysis. The following standard assumptions have been applied:

- The costs are the capital costs for implementation of the scheme only;
- Costs do not include provisions for consultancy, design, supervision, panning process, permits, environmental assessment or optimum bias;
- No provision is made for weather (e.g. winter working);
- No provision is made for access constraints;
- No provision is made for remediation of contaminated land;
- Where require, it will be stated if costs include approximate land acquisition components;
- No operational or maintenance costs are included;
- No provision is made for disposal of materials (e.g. for flood storage or soakaway clearance).

TABLE 15-6: MEASURE OF UNIT COSTS FOR OPTIONS

	Measures	Cost Rate	Unit	Notes/Source
Source	Green Roofs	£146	m^2 of roof	GLA – Living Roofs and Walls, Technical Report Supporting London Plan Policy (2008)
	Water Butts	£240	Per water butt	Stovin & Swan (2007), Table 2; includes for installation and connection of feeder pipe
	Soakaways	£219	m^3 of stored volume	CIRIA SuDS Manual (2007)
	Swales	£20	m^2 of swale area	CIRIA SuDS Manual (2007) Stovin & Swan (2007) – Retrofit Suds, Cost estimates and decision support tools
	Permeable Paving	£66	m^2 of surface	CIRIA SuDS Manual (2007) Stovin & Swan (2007) – Retrofit Suds, Cost estimates and decision support tools
	Rainwater Harvesting / Grey Water Recycling	£1100	m^3 of stored volume	Adapted from: http://www.rainwaterharvesting.co.uk/
	Detention Basins	£22	m^3 of detention volume	CIRIA SuDS Manual (2007)

TABLE 15-6: MEASURE OF UNIT COSTS FOR OPTIONS				
	Ponds and Wetlands	£33	m^3 of detention volume	Note: Excludes disposal of excavated material or inlet and outlet control structures. Suggest allow for £4000 for inlet and outlet control structures per pond. SPONS (2007), pg. 230 CIRIA SuDS Manual (2007)
Pathway	Introduction of new culverts / increasing capacity	-	m of culvert	Dependant on length, depth and location of culverts. General guidelines available from: Environment Agency Flood Risk Management Estimating Guide (2010) SPONS (2007), pg. 214 and 230
	Increase number and size of gullies	£215	per gully	SPONS Pricebook (2012)
	Separate Sewer Systems	£175	per m length	Stovin & Swan (2007) – Retrofit Suds, Cost estimates and decision support tools
	Improved Maintenance Regimes	Dependant on scale, unit cost of council resource and current maintenance costs		
	Incorporation of Overland Flow Routes – Blue Corridors	Dependant on route, length and extent of works required		
	Earth Bunds (managing flow routes)	£30	m^3 of imported material	SPONS (2007), pgs. 172, 174, 181, 392.
	Infiltration Ditches	£95	per m length	Stovin & Swan (2007), Table 2; based on BRE365 design example: 0.6 m x 2.5 m, 1.5 m effective depth. Includes excavation, filler material, distributor pipe, geotextile filter membrane, backfilling and reinstatement. Does not include connection costs.
	Land Management Practices	Dependant on scale and type of land use practise changes. May have to allow for landowner agreement, compensation of compulsory purchase orders.		
	De-culverting Watercourse(s)	Dependant on route, length and extent of works required		
Receptor	Improved weather warning / flood warning	Dependant on scale of area to be warned and whether and how much telemetry is required. As a guide, a single depth transducer gauge can be installed and commissioned for approximately £1500. Management of recipient databases and dissemination systems would need to be allowed for.		

TABLE 15-6: MEASURE OF UNIT COSTS FOR OPTIONS				
	Planning Policies	This might include costs for implement new systems, such as additional consenting and development control consultation, design and production of proforma, literature (including advice and examples) and website content development. Potential for costs to be offset against additional charges on applications or pre-application consultation fees.		
	Temporary / Demountable defences	£25000	per property	Adapted from: http://www.floodguard.co.uk/ http://www.ukfloodbarriers.com/
	Education and Social Awareness	£1000	per event	Estimated based on two people attending, production of materials, transportation of equipment and rental of venue. Average from liaison with Environment Agency and LLFA teams from across the country.
	Improved Resilience and / or Resistance	£22000	per property	Adapted from Defra 'Flood Resistance and Resilience Solutions: An R & D Scoping Study'. (2007)

As a result, costs have been provided as a series of cost bands, reflecting the strategic nature of the SWMP study and options identification. The costs bands considered are:

- Band 1 – Less than £25,000;
- Band 2 – £25,000 to £50,000;
- Band 3 – £50,000 to £100,000;
- Band 4 – £100,000 to £250,000;
- Band 5 – £250,000 to £500,000;
- Band 6 – £500,000 to £1,000,000;
- Band 7 – £1,000,000 to £10,000,000;
- Band 8 – Greater than £10,000,000.

Once the preferred option(s) have been determined this should be re-visited initially at a high level to determine the potential viability of the preferred option, prior to undertaking a more detailed cost benefit analysis.

For each of the CDAs, flood management options have undergone a 'screening' assessment using Tables 15.3 to 15.6 and have determined the viability of a range of options at a high level. These should be used by LCC to develop their Action Plan (Phase 4). The following sections provide the 'broad scale' options that can be implemented across Loughborough and options that can be considered for each CDA (where broad scale options can also be implemented).

15.5 Loughborough Broad Scale Options

In addition to the options available at the CDA level, a number of broad scale options and policies have been identified that LCC may consider adopting as part of their responsibility as LLFA for local flood risk management. The preferred options for implementation across the whole of Loughborough are listed below and described in more detail in the following sections.

- Raising Community Awareness;
- Improving Resilience to Flooding;
- Improvements to Maintenance of Drainage Network;
- Planning and Development Policies;
- Water Conservation.

15.5.1 Raising Community Awareness

A 'quick win' action that could be implemented in the short-term is to increase awareness of flooding within communities at risk across Loughborough. This could be achieved through a number of measures including:

- Newsletters (Figure 15.1shows an example from the Norwich SWMP);
- Drop-in surgeries;
- Promotion on LCCs and CBCs website;
- Community Flood Plans.

The aim of these actions is to raise awareness and improve understanding of the risks and consequences of surface water flooding amongst local communities and, through this, encourage residents to take up measures to combat flooding to help themselves. Such measures may include installation of water butts to capture roof runoff and consideration of the extent and materials used when replacing permeable areas within hard standing areas within their property, e.g. through the installation of driveways and patios.

Figure 15.1: Example Newsletter (URS, 2011)

Recommendation: Consider and implement options for raising community awareness including letter drop, public meetings, and/or preparation of Community Flood Plans.	
Option 1	Undertake a letter drop to highlight the improvement works that have been implemented as well as works that are planned for the future in specific locations.
Option 2	A public meeting could be held following the letter drop where residents can highlight any issues. This could include a talk from the key partner organisations – LCC, the EA and ST – on the work that is being undertaken and who is responsible. Such a meeting could also outline how residents can help themselves and highlight their responsibility for maintaining private drainage, soakaways, driveway drainage etc.
Option 3	Consider preparing a Community Flood Plan for those communities identified to be at high risk.
Option 4	More use could be made of the current increase in exposure of residents to the internet and social media. This could be achieved through the development of a specific local flood risk management webpage on the LCC website, or through making use of social media such as Facebook and Twitter.

15.5.2 Improving Resilience to Flooding

One method to reduce the risk of surface water flooding to properties is raising property thresholds. Raising the thresholds of entrances to property land, e.g. where there are currently gates adjacent to paved walls, may offer flood resilience benefits.

Raised thresholds as shown in Photograph 15-1 and Photograph 15-2 are a useful and accepted method of defending property against flooding. However, this can conflict with possible accessibility issues within Part M, Section 6 of the Building Regulations 2004 and the requirements of the Disability Discrimination Act 1996 (DDA). In Photograph 15-2, a brick wall has been constructed across the property driveway in order to protect the property from flooding. Until such time as national guidance or best practice is available, LCC and CBC should, when required, work with residents to realise suitable, sensible and cost effective solutions which allow access and deliver mitigation against possible flooding.

Photograph 15-1: Raised Driveway

Photograph 15-2: Raised Boundary Threshold

Recommendation: Consider opportunities to promote awareness of property level thresholds, particularly in areas of higher flood risk.	
Option 1	It is recommended that LCC and CBC aim to raise the awareness of the options for increasing property thresholds to protect against flooding.
Option 2	It is recommended that LCC and CBC work with residents to realise suitable, sensible and cost effective property level resilience to potential flooding (through, for example raising property thresholds to 100mm), particularly in areas where properties are known / identified to be susceptible to surface water flooding.

Flood resilience measures to be utilised at individual properties also extend to include non-return valves, flood barriers and floodgates. Given the potential issues with the non-application of measures for numerous reasons (i.e. flooding during hours of darkness, residents are not at home), preference should be given to the installation of 'fix and forget' measures such as:

- Self-sealing UPVC doors;
- Non-return valves;
- Air brick covers.

Although such measures would provide benefits to any property at risk of flooding from surface water (or other sources), initial focus should be towards properties identified within flooding hotspots.

Recommendation: Consider opportunities to promote awareness of property level resilience measures, particularly in areas of higher flood risk.	
Option 1	It is recommended that LCC and CBC aim to raise the awareness of the options for implementing 'fix and forget' measures to individual properties.
Option 2	It is recommended that LCC and CBC work with residents to realise suitable, sensible and cost effective property level 'fix and forget' measures, particularly in areas where properties are known / identified to be susceptible to surface water flooding.

15.5.3 Improvements to Maintenance of Drainage Network

The management and maintenance of the urban drainage network in Loughborough is the responsibility of a number of organisations:

- Leicestershire County Council – highways drainage including gully pots and soakaway systems, ordinary watercourses (where not the responsibility of other riparian owners);
- Severn Trent Water – main sewers and lateral sewers;
- Environment Agency – culverts, raised defences, trash screens, main river channels;
- Canal and River Trust – interactions with watercourses;
- Network Rail – railway drainage and culverts beneath raised railway embankments;
- Private Ownership – this includes riparian owners (for ordinary watercourses), private roads (drainage) and private maintenance companies responsible for SuDS and / or drainage systems as part of private development where the responsibility has not been transferred to others.

Effective cleansing of gully pots is fundamental to the drainage across Loughborough and is particularly important for more frequent lower magnitude events i.e. less than 1 in 30 year. Fallen leaves, debris and a build up of silt area the main causes of blockages in the highway

drainage. In addition, vegetation growth also impedes drainage. In areas with steeper gradients, surface water also has the potential to bypass gully pots due to high flow velocities.

LCC undertake regular maintenance of highway drains but due to the extent of the administrative area, length of highway network and access to gully pots within residential areas, prioritisation of resources is required. Options that could be considered by LCC with respect to highway drainage maintenance include:

Recommendations: Consider opportunities for on-going improvements to the maintenance of the drainage network.	
Option 1	Gullies that are known to flood could be painted to encourage residents to check if they are blocked and to avoid parking directly over them thereby preventing access for gully clearing team. The EA 'yellow fish' scheme operates in a similar manner, whereby key drainage infrastructure is painted with a yellow fish logo, where it is thought to drain directly to a watercourse.
Option 2	Encourage gully cleansing contractors to use powers to enforce movement of parked vehicles to ensure all gullies are regularly cleared. Education of the public with regards to parking over gullies, or publishing gully cleansing schedules on the council website would also reduce the instances of non-clearance due to parked vehicles.
Option 3	Coordinate timing of gully cleansing rounds to ensure that they do not coincide with school opening and closing times and other peak times that would prevent gaining access to gullies.
Option 4	Focus attention on the maintenance of gully pots in the identified CDAs which are considered to be high risk.
Option 5	Develop / enhance database of all LCC owned flood / drainage assets (in line with FWMA requirements).
Option 6	As LLFA, LCC must record and investigate incidents of 'significant' flooding. It is recommended that the source of flooding be recorded, e.g. gully surcharging, to inform maintenance priorities.

15.5.4 Sustainable Drainage Systems

SuDS techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc.). Various SuDS techniques are available and operate on two main principles; attenuation and infiltration. All systems generally fall into one of these two categories, or a combination of the two.

Under the FWMA, LCC (as a LLFA) has new responsibilities as a SuDS Approval Body (SAB) for approving, adopting and maintaining SuDS.

SuDS Approval Body (SABs)

SABs were given responsibility under the FWMA for approving, adopting and maintaining drainage plans and SuDS schemes that meet the National Standards for sustainable drainage. Any drainage scheme for more than one property in Loughborough will need to be approved by LCC prior to the commencement of construction work. SuDS approval will run in parallel with the general planning applications process. LCC will also be responsible for placing all adopted SuDS on their asset register to ensure that their location is known, and their functionality is not disrupted by future developments.

National Standards for Sustainable Drainage Systems

Defra is developing National Standards to be used in England in order to manage surface runoff in accordance with the FWMA. The National Standards were released for public consultation in December 2011, which closed on 13th March 2012. The National Standards set out what to design and construct in order to obtain approval from the SAB, and for operating and maintaining SuDS which the SAB adopts.

15.5.5 Infiltration SuDS

Infiltration SuDS rely on discharges to the ground, where conditions are suitable. Therefore, these systems are reliant on the local ground conditions (i.e. permeability of soils and the surface and sub-surface geology, contaminated land, the groundwater table depth and the importance of underlying aquifers as a potable resource) for their successful operation.

Development pressures, particularly the desire to maximise the developable area within a site, may constrain the area of a site that is set aside for infiltration systems. This can be overcome through the use of a combined approach with both attenuation and infiltration techniques. For example, attenuation storage may be provided in the sub-base of a permeable surface, within the chamber of a soakaway or as a pond/water feature.

Permeable surfaces are designed to intercept rainfall and allow water to drain through to a sub-base. The use of a permeable sub-base can be used to temporarily store infiltrated runoff beneath the surface and allows the water to percolate into the underlying soils. Alternatively, stored water within the sub-base may be collected at a low point and discharged from the site at an agreed rate.

Permeable paving prevents runoff during low intensity rainfall, however, during intense rainfall events some runoff may occur from these surfaces.

Programmes should be implemented to ensure that permeable surfaces are kept well maintained to ensure the performance of these systems is not reduced. The use of grit and salt during winter months may adversely affect the drainage potential of certain permeable surfaces.

Types of permeable surfaces include:

- Grass/landscaped areas;
- Gravel;
- Solid Paving with Void Spaces;
- Permeable Pavements.

Where permeable surfaces are not a practical option more defined infiltration systems are available. In order to infiltrate the generated runoff to ground, a storage system is provided that allows the infiltration of the stored water into the surrounding ground through both the sides and base of the storage. These systems are constructed below ground and therefore may be

advantageous with regards to the developable area of the site. Consideration needs to be given to construction methods, maintenance access and depth to the water table. The provision of large volumes of infiltration/sub-surface storage has potential cost implications. In addition, these systems should not be built within 5 m of buildings, beneath roads or in soil that may dissolve or erode.

Various methods for providing infiltration below the ground include:

- Geocellular Systems;
- Filter Drain;
- Soakaway (Chamber);
- Soakaway (Trench);
- Soakaway (Granular Soakaway).

As part of the Phase II SWMP, expected permeability was mapped at the strategic level for Loughborough. This was based on underlying bedrock and superficial deposits from BGS mapping and identified the expected permeability in for bands:

- High;
- Moderate to High;
- Low to Moderate;
- Low.

In general, areas with 'High' and 'Moderate to High' are considered to be potentially suitable whereas areas with 'Low' and 'Low to Moderate' are considered to be less suitable. However, it should be noted that at a site specific level, infiltration testing should be undertaken to confirm local conditions. In addition, Source Protection Zones (SPZs) and associated guidance from the EA should also be taken into account.

15.5.6 Attenuation SUDS

If ground conditions are not suitable for infiltration techniques then management of surface water runoff prior to discharge should be undertaken using attenuation techniques. Discharge rates from a site can be attenuated to reduce flood risk both within and to the surrounding area. It is important to assess the volume of water requiring storage that would enable water to be discharged from a site an agreed discharge rate. The amount of storage required should be calculated prior to detailed design of the development to ensure that surface water flooding issues are not created within the site.

The rate of discharge from a site should be agreed with LCC (as the LLFA and SAB) and the EA. Where surface water cannot be discharged to ground or via a local watercourse, liaison with ST will be required to should be undertaken to agree rates of discharge into the surface water sewer.

Any proposed adoptable SuDS scheme will need to be submitted to the SAB (LCC in this case) for approval.

Large volumes of water may be required to be stored on site. Storage areas may be constructed above or below ground. Depending on the attenuation/storage systems implemented, appropriate maintenance procedures should be implemented to ensure continued performance of the system. On-site storage measures include basins, ponds, and other engineered forms consisting of underground storage.

Basins are areas that have been contoured (or alternatively embanked) to allow for the temporary storage of runoff from a developed site. Basins are designed to drain free of water and remain waterless in dry weather. These may form areas of public open space or recreational areas. Basins also provide areas for treatment of water by settlement of solids in ponded water and the absorption of pollutants by aquatic vegetation or biological activity. The construction of basins uses relatively simple techniques. Local varieties of vegetation should be used wherever possible and should be fully established before the basins are used. Access to the basin should be provided so that inspection and maintenance is not restricted. This may include inspections, regular cutting of grass, annual clearance of aquatic vegetation and silt removal as required.

Ponds are designed to hold the additional surface water runoff generated by the site during rainfall events. The ponds are designed to control discharge rates by storing the collected runoff and releasing it slowly once the risk of flooding has passed. Ponds can provide wildlife habitats, water features to enhance the urban landscape and, where water quality and flooding risks are acceptable, they can be used for recreation. It may be possible to integrate ponds and wetlands into public areas to create new community ponds. Ponds and wetlands trap silt that may need to be removed periodically. Ideally, the contaminants should be removed at source to prevent silt from reaching the pond or wetland in the first place. In situations where this is not possible, consideration should be given to a small detention basin placed at the inlet to the pond in order to trap and subsequently remove the silt. Depending on the setting of a pond, health and safety issues may be important issues that need to be taken into consideration. The design of the pond can help to minimise any health and safety issues (i.e. shallower margins to the pond reduce the danger of falling in, fenced margins).

Various types of ponds are available for utilising as SuDS measures and these include:

- Balancing/Attenuating Ponds;
- Flood Storage Reservoirs;
- Lagoons;
- Retention Ponds;
- Wetlands.

Site constraints and limitations such as developable area, economic viability and contamination may require engineered solutions to be implemented. These methods predominantly require the provision of storage beneath the ground surface, which may be advantageous with regards to the developable area of the site but should be used only if methods in the previous section cannot be used. When implementing such approaches, consideration needs to be given to construction methods, maintenance access and to any development that takes place over the storage facility. The provision of large volumes of storage underground also has potential cost implications.

Methods for providing alternative attenuation include:

- Deep Shafts;
- Geocellular Systems;
- Oversized Pipes;
- Rainwater Harvesting;
- Tanks;
- Green and Brown Bio-diverse Roofs.

In some situations it may be preferable to combine infiltration and attenuation systems to maximise the management of surface water runoff, developable area and green open space.

15.5.7 Planning and Development Policies

For general development, planning policy contained within the Local Plan should reflect policy within the NPPF regarding the management of surface water and the use of SuDS. In addition, commencement of Schedule 3 of the FWMA regarding National Standards for SuDS and the requirements for approval of SuDS for adoption by LLFAs should be reflected within planning policy.

Where known issues exist with regard to surface water flooding (or from a combination of sources) and redevelopment or new development is planned, where practicable, betterment on the existing situation should also be sought. An allowance for the effects of climate change also needs to be included in line with National Policy.

Recommendation: Ensure appropriate Spatial Planning and Development Control Policies are in place for management of Surface Water and explore education / awareness opportunities for general public regarding SUDS guidance and 'best practice'.	
Option 1	CBC[10] spatial planning policies should reflect national planning policy and where practicable encourage betterment with respect to the existing situation where surface water flooding issues are present. This may be implemented through Supplementary Planning Documents for individual settlements.
Option 2	CBC development control policies should be aligned and recognise the impending requirements of the National Standards for SuDS and their adoption by LLFAs. Guidance at the pre-planning application stage could be developed to assist developers at the early stage.

15.5.8 Paved Gardens Policy

Impermeable paving in gardens can significantly increase surface water runoff entering the local drainage network. From the 1st October 2008, permitted development rights that allow householders to pave their front garden with hard standing without planning permission was removed. Residents should be encouraged to design their gardens in a way that optimises drainage and reduces runoff (see Photograph 15-3 and Photograph 15.4). LCC and CBC should publicise this issue and refer to standard guidance on the surfacing of front gardens provided by the CLG and EA in September 2008[11].

[10] This is for CBC, however, spatial planning policies for Minerals and Waste plans by LCC should also incorporate these.
[11] Department for Communities and Local Government, 2008, Guidance on the Permeable Surfacing of Front Gardens http://www.communities.gov.uk/documents/planningandbuilding/pdf/pavingfrontgardens.pdf

Photograph 15-3: Reduced paved area

Photograph 15-4: Permeable surfacing

Recommendation: Ensure appropriate Development Control Policy for repaving of gardens or driveways and explore education / awareness opportunities for general public regarding SUDS guidance and 'best practice'.	
Option 1	LCC and CBC could encourage residents to ensure that paved areas in front gardens drain onto flower beds rather than running onto the highway.
Option 2	LCC and CBC could aim to raise awareness of the options for installation and maintenance of permeable surfaces within property grounds.
Option 3	LCC and CBC could aim to provide an information portal that residents can consult for further information on permeable paving and other SuDS measures, including links to other organisations (e.g. EA) who can provide 'best practice' guidance and examples.
Option 4	LCC and CBC could aim to educate / train their staff to ensure that planning officers: • Are aware of the existing planning permissions, guidance and best practice, • Are in a position to educate the public if enquiries are made regarding planning permission to change their drive/garden, • Can identify / enforce for non-compliance or non-permitted conversion (in particular in PPAs where it exacerbates the problem).

15.5.9 Water Conservation

Water conservation is a key option for reducing peak discharges and in turn downstream flood risk. This can be applied using a number of options including planning led encouragement of the use of rainfall in rainwater harvesting systems and property level use of water butts. Both are described in more detail below.

15.5.10 Rainwater Harvesting

The potential for the use of rainwater harvesting should be jointly led by LCC, CBC and ST. Promotion of the benefits of such schemes could be rolled out across Loughborough to reduce costs. The principle of rainwater harvesting in both domestic and commercial property is the same. Rainwater from roof areas is passed through a filter and stored within large underground tanks. When water is required, it is delivered from the storage tank to toilets, washing machines and garden taps for use. If the tank becomes low on stored water, demand is topped up from the mains supply. Any excess water can be discharged via an overflow to a soakaway or local drainage network.

Rainwater harvesting systems could be retrofitted to council owned properties, or large sites within Loughborough. A case study for Southampton University Student Services Building is described below, with an example layout of a system illustrated in Figure 15.2:

- Roof Area: 1000 m^2;
- Underground storage tank: 15,000 litres;
- Building occupancy: 150 people;
- Planned usage: 21 toilets and 3 urinals;
- Expected annual rainwater collection: 410,000 litres;
- Capital cost: £4,325;
- Expected payback time is 5.3 years (based on Southern Water 2006 tariff).

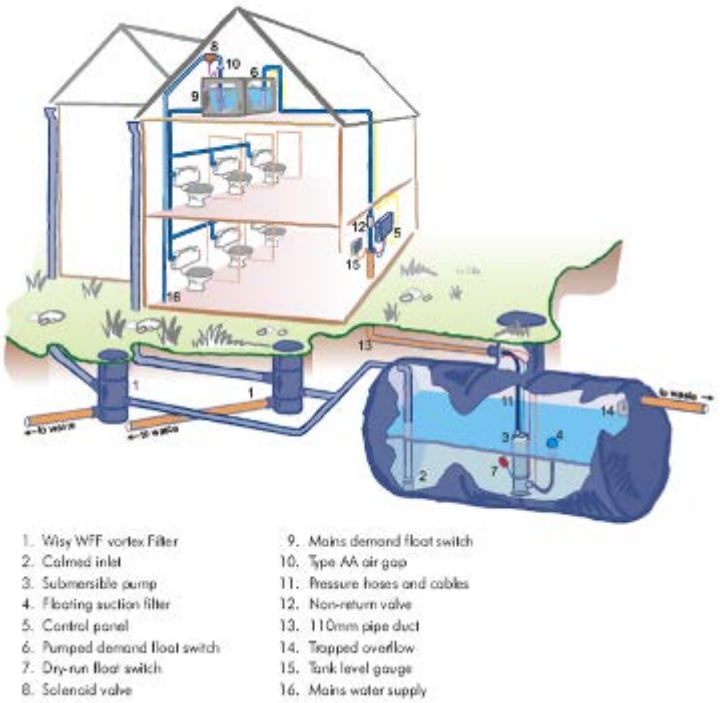


Figure 15-2: Example Rainwater Harvesting System in a Commercial Property[12]

Recommendation: Consider opportunities to promote rainwater harvesting in both new and existing development throughout Loughborough	
Option 1	LCC and CBC could consider providing an incentive scheme for the use of rainwater harvesting systems across Loughborough. This may be linked to the Council's sustainability checklist.
Option 2	LCC and CBC could consider retrofitting rainwater harvesting systems on LCC owned properties, such as schools, for example, which offer educational opportunities as well as local surface water flood mitigation.
Option 3	LCC and CBC could explore potential opportunities for the installation of rainwater harvesting systems on new or regenerated development areas (in particular where there is high footfall / potential for use).

[12] Source: Rainwaterharvesting systems UK.

15.5.11 Water Butts

One of the preferred simple measures to reduce peak discharges and downstream flood risk is the installation of water butts on all new development within Loughborough, and retrofitting to existing properties where possible in area at greatest risk of surface water flooding. In areas where low or moderate infiltration constrains use of soakaways, the wholesale implementation of water butts can significantly reduce peak discharges.

Water butts often have limited storage capacity given that when a catchment is in flood, water butts are often full, however it is still considered that they have a role to play in the sustainable use of water and there is potential to provide overflow devices to soakaways or landscaped areas to ensure that there is always a volume of storage available.

Whether to construct formal spill pipes to soakaways, or to allow simple overspill to the adjacent ground are detailed decisions that will need to be assessed on a site-by-site basis. Such a decision will have only minor significance on the proposals with respect to the surface water drainage.

TABLE 15-7: RAINWATER HARVESTING, WATER BUTTS

Description	Benefits	Impacts
Installation of water butts for all new development where feasible.	Ties in with SuDS hierarchy and reduces peak discharges to surface water.	Positive impacts to sustainability and water re-use.
Retrofit water butts on all existing development.	Supplementary benefits beyond regeneration and redevelopment sites (volumetric reduction with opportunity for complimentary water quality improvements).	Currently no available incentives to encourage homeowners to install water butts.

Figure 15-3: Example of a 100 Litre Water Butt Retrofitted to Existing Development

Recommendation: Consider opportunities to promote use of water butts in both new and existing development throughout Loughborough	
Option 1	Consider installation of water butts for all new development. This ties in with the SuDS hierarchy and reduces peak discharges to surface water sewers and is likely to have positive impacts to sustainability and water re-use.
Option 2	Consider retrofitting water butts on all existing development. This provides supplementary benefits beyond regeneration and redevelopment sites (volumetric reduction with opportunity for complementary water quality improvements). However there are currently no available incentives to encourage homeowners to install water butts.
Option 3	It is recommended that Loughborough promote the use of water butts across the administrative area and provide information on costs, suppliers, installation and benefits.

15.6 Potential Options by Critical Drainage Areas

Potential preferred options for each CDA have been identified and split into:

- General Options: These are based on the broad scale options in Section 15.5. These are typically non-structural measures that can easily be implemented within the CDA or wider area;
- Preferred Options: These are typically structural measures where physical works are required or installation of measures is required (water butts, flood resilient doors). These have typically been limited to a maximum of three options to identify options that are likely to be most appropriate for the CDA.

It should be noted that in some instances, preferred options may be a combination of measures due to the nature of the CDA.

Willow Brook CDA	
General Options	• Rainwater Harvesting (Water Butts); • Planning Policies; • Education and Social Awareness; • Improved Resilience and / or Resistance.
Preferred Options	**Improved Maintenance Regimes**: changes to, or improvements to the maintenance regime for highways/localised drainage network to reduce blockage and increase effectiveness of conveyance. Raising community awareness with regard to responsibilities for maintenance and possible amenity benefits should be undertaken. **Outline Cost**: Dependent on scale, unit cost of resource and current costs, plus one off community awareness raising event (estimated <£25,000 per annum)
	Increased Drainage System Capacity: as indicated in the IUD study an additional outfall to the watercourse that runs to the south of Alan Moss Road would take water from the pipe runs along Knighthorpe Road and potentially alleviate flooding in this location. Since the flooding in this location is again due to incapacities in the upstream system, this may not be an adequate solution and further modelling would be required to determine this. **Outline Cost**: Feasibility Study <£25,000, Implementation – subject to number and size of gully pots and culverts lengths.
	Land Management Practices: Upstream of Willow Brook CDA, there may be opportunities to promote land management practices to attenuate runoff and alleviate potential issues downstream. This will require liaison between the local land owners and LCC to identify appropriate solutions. **Outline Cost**: Review of existing upstream contributing area and potential SuDS options (e.g. detention basins etc.) <£25,000.

Grammar School Brook CDA	
General Options	• Planning Policies; • Improved Resilience and / or Resistance.
Preferred Options	**IUD study 'quick wins':** The IUD report proposes 'quick win' interventions within five areas of the Grammar School Brook CDA (namely: Holt Drive, Beacon Road, Beaumont Road, Castledine Street and the Territorial Army Centre). The five interventions predominantly involve upsizing of existing sewer networks, provision of additional online/offline storage and the reconfiguration of street levels to alleviate flood risk. It is important to note that these are just theoretical schemes and that a more detailed analysis would be required to inform detailed designs. **Outline Cost**: NA
	Education and Social Awareness: potential to combine awareness of flooding from surface water and other sources (fluvial and groundwater) with property levels measures (e.g. reducing runoff from dwelling) via targeted leaflet providing information. **Outline Cost**: Dependent on number of properties target, leaflet production costs and other associated costs (estimated <£25,000 per annum).
	Water butts: interception of rainfall at source across the catchment to both attenuate flows and re-use for amenity purposes. It is noted that an assessment of housing type will be required within the CDA to assess housing type to identify where option may not be feasible (e.g. roof water pipes discharge directly onto street). In addition, community awareness and buy-in will be required. **Outline Cost**: £250,000 - £500,000 based on assumption of 40 dwellings per hectares across the wider catchment.

Wood Brook CDA	
General Options	• Planning Policies; • Improved Resilience and / or Resistance.
Preferred Options	**Land Management Practices**: Upstream of Wood Brook CDA, is the Option B potential growth area, as identified in the Core Strategy Supplementary Consultation document (June 2012). Therefore, opportunities may exist to incorporate SuDS features into the proposed development to alleviate potential issues downstream. This will require liaison between the proposed developer and LCC at the pre-application / master planning stage to identify appropriate solutions. **Outline Cost**: Review of existing upstream contributing area and potential SuDS options (e.g. detention basins etc) <£25,000. Implementation will depend on the master planning and timing of proposed development.
	Improved Maintenance Regimes/Improving Drainage Capacity: changes to, or improvements to the maintenance regime for highways/localised drainage network to reduce blockage and increase effectiveness of conveyance in downstream areas (may include investigation of surface water sewer capacity and potential for upgrade). Community awareness may benefit to explain why and when works are taking place. In addition, changes or improvements to the maintenance of the Wood Brook and confirmation of responsibilities. Also collaborative working with the Environment Agency because lower reaches is classified as Main River. Raising community awareness with regard to responsibilities may be beneficial. **Outline Cost**: Dependent on scale, unit cost of resource and current costs, plus one off community awareness raising event (estimated <£25,000 per annum)
	Water butts: interception of rainfall at source across the catchment to both attenuate flows and re-use for amenity purposes. It is noted that an assessment of housing type will be required within the CDA to assess housing type to identify where option may not be feasible (e.g. roof water pipes discharge directly onto street). In addition, community awareness and buy-in will be required. **Outline Cost**: £250,000 - £500,000 based on assumption of 40 dwellings per hectares across the wider catchment.

Burleigh Brook CDA	
General Options	• Planning Policies; • Improved Resilience and / or Resistance.
Preferred Options	**Improved Maintenance Regimes – Main Rivers**: changes to, or improvements to the maintenance regime on the local watercourse may increase the conveyance capacity of the system and reduce localised flooding. This could include changes to the trash screen design within Burleigh Brook at the junction between Alan Moss Road and Epinal Way, which has previously resulted in localised flooding. **Outline Cost**: Improved maintenance dependent on scale, unit cost of resource and current costs. Trash screen feasibility study (estimated <£25,000 per annum)
	Land Management Practices: Upstream of Burleigh Brook CDA, there may be opportunities to promote land management practices to attenuate runoff and alleviate potential issues downstream. This will require liaison between the local land owners and LCC to identify appropriate solutions. **Outline Cost**: Review of existing upstream contributing area and potential SuDS options (e.g. detention basins etc) <£25,000.
	Water butts: interception of rainfall at source across the catchment to both attenuate flows and re-use for amenity purposes. It is noted that an assessment of housing type will be required within the CDA to assess housing type to identify where option may not be feasible (e.g. roof water pipes discharge directly onto street). In addition, community awareness and buy-in will be required. **Outline Cost**: £250,000 - £500,000 based on assumption of 40 dwellings per hectares across the wider catchment.

15.7 Recommendations for Next Steps and Quick Wins

Taking into account the nature of the surface water flooding in Loughborough, the options identified through the Phase III Options Assessment, and requirements under the FWMA and the FRR, it is considered that LCC should prioritise the following actions in the short to medium-term:

- Identify and record surface water assets as part of the LCC Asset Register, prioritising those areas that are known to regularly flood and are therefore likely to require maintenance or upgrading in the short-term. Investigate any 'significant' surface water flood events under the responsibilities of the FWMA;
- Consider the development of an 'Information Portal' via the LCC website, including links to the relevant EA and National Flood Forum web pages that provide advice on measures that can be taken by residents to mitigate surface water flooding to / around their property. This could be developed to include:
    - A list of appropriate property-level flood risk resilience measures that could be installed in a property;

  - A link to websites / information sources providing further information, such as the EA and National Flood Forum;
  - An update on work being undertaken by LCC and/or other Stakeholders to address surface water flood risk.

- Prepare a Communication Plan to effectively communicate and raise awareness of surface water flood risk to different audiences using a clearly defined process for internal and external communication with stakeholders and the public;
- Determine a protocol for communicating local flood risk and disseminating the findings of the SWMP. This should engage the public in terms of raising awareness of local flood risk across Loughborough. Such options for communicating local flood risk include:
  - Host community workshops or drop-in sessions;
  - Development of a specific local flood risk management webpage on the council website;
  - Publication of a local flood risk management newsletter;
  - Publication of articles in the local newspaper or council magazine;
  - Raise awareness via the local television and radio stations;
  - Utilise online social media sources (Facebook and Twitter).
- Undertake a feasibility study to determine the potential effectiveness of providing (or subsidising) properties in the identified flooding hotspots with water butts to reduce runoff during rainfall events. Any such scheme would also need to done in conjunction with raising public awareness with regards to managing levels in their water butts to ensure they are not full at the start of a rainfall event. In addition, working in collaboration with ST may provide wider benefits through reduction in surface water flows within sewer assets;
- In conjunction with LCC (and partners), undertake a Pre-Feasibility Study to determine the viability of the options identified for reducing flood risk in CDAs where more investigation is required. The study should consider the following:
  - The upstream drainage network;
  - Details of the properties effected by flooding;
  - Determination of the local drainage capacity and identify flow constraints;
  - Determine condition of culverted watercourses, highways drainage, sewer network and open channel sections;
  - Review potential options identified thus far and determine their feasibility to be taken forward for more detailed assessment;
  - Determine more detailed costs and associated benefits with short-listed options.
- Use the findings of the SWMP to review the current maintenance regime for ordinary watercourse works (including channel clearance and trash screen clearance);
- Use the findings of the SWMP to review the current regime for gully cleansing and maintenance and amend if necessary.

APPENDIX A – GROUNDWATER ASSESSMENT