



Environment & Regeneration Surface Water Flooding Evidence Base

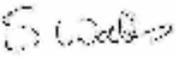
May 2012

Version: Final 04

Revision Schedule:
Surface Water Flooding Evidence Base (May 2012)

	Originator	Checked by	Reviewed by	Approved by
Original	Name Jonathan Parry	Name	Name Melanie Hughes	Name
Date December 2011 Draft 01	Signature 	Signature	Signature	Signature
Document Status: Draft 01 (Issued for Review by Planning Policy)				

Revision	Name Jonathan Parry	Name	Name	Name
Date January 2012 Draft 02	Signature 	Signature	Signature	Signature
Document Status: Draft 02 (Amendments made as requested by MH) submitted for comment to JT				

Revision	Name Jonathan Parry	Name Jim Turton	Name Sharon Walls	Name
Date January 2012 Draft 03	Signature 	Signature 	Signature 	Signature
Document Status: Draft 03 (Issued for approval)				

	Originator	Checked by	Reviewed by	Approved by
Revision	Name Jonathan Parry	Name Jim Turton	Name Jim Turton	Name Sharon Walls
Date May 2012 Final 04	Signature 	Signature 	Signature 	Signature 
Document Status: Final				

	Name	Name	Name	Name
Revision				
Date	Signature	Signature	Signature	Signature
Document Status:				

	Name	Name	Name	Name
Revision				
Date	Signature	Signature	Signature	Signature
Document Status:				

Warrington Borough Council
 Environment & Regeneration
 New Town House
 Buttermarket Street
 Warrington
 WA1 2NH
 Tel: 01925 44 33 22
 Fax: 01925 44 32 55
www.warrington.gov.uk

Glossary

Term	Definition
AOD	Above ordinance datum
AStGwF	Areas Susceptible to Groundwater Flooding
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water
AMP	Asset Management Plan
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
AStSWF	Areas Susceptible to Surface Water Flooding
BGS	British Geological Survey
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
CDA	Critical Drainage Area
COW	Critical Ordinary Watercourse
Critical Drainage Area	A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure
CFMP	Catchment Flood Management Plan
CIRIA	Construction Industry Research and Information Association
Civil Contingencies 2004	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.
CLG	Government Department for Communities and Local Government
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Culvert	A channel or pipe that carries water below the level of the ground
DEFRA	Department for Environment, Food and Rural Affairs
DEM	Digital Elevation Model
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.
DTM	Digital Terrain Model
EA	Environment Agency
EC	European Community
EU	European Union

Term	Definition
Indicative Flood Risk Areas	Areas determined by the Environment Agency as indicatively having a significant flood risk, based on guidance published by DEFRA and WAG (Welsh Assembly Government) and the use of certain national datasets. These indicative areas are intended to provide a starting point for the determination of Flood Risk Areas by Lead Local Flood Authority's (LLFA)
FMfSW	Flood Map for Surface Water
Flood Defence	Infrastructure used to protect an area against floods, such as floodwalls and embankments; they are designed to a specific standard of protection (design standard)
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by DEFRA & WAG
Flood Risk Regulations 2009	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Flood and Water Management Act 2010	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a Main River
FRR	Flood Risk Regulations
FWMA	Flood and Water Management Act 2010
GIS	Geographical Information Systems
IPCC	Intergovernmental Panel on Climate Change
IUD	Integrated Urban Drainage
LDF	Local Development Framework
LGF	Local Government Forum
LLFA	Lead Local Flood Authority
Lead Local Flood Authority	Local Authority responsible for taking the lead on local flood risk management
LiDAR	Light Detection and Ranging (topographic data obtained using laser technologies, usually obtained from aeroplanes and helicopters)
Local Resilience Forum	A multi-agency forum, bringing together all the 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.
LPA	Local Planning Authority
LRF	Local Resilience Forum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NRD	National Receptor Dataset – a collection of risk receptors produced by the Environment Agency

Term	Definition
OFWAT	Water Services Regulation Authority
OS	Ordinance Survey
Ordinary Watercourse	All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, Internal Drainage Boards (IDBs)
Partner	A person or organisation with responsibility for the decision or actions that need to be taken.
PFRA	Preliminary Flood Risk Assessment
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.
PPS 25	Planning Policy Statement 25: Development and Flood Risk
PA	Policy Area
Policy Area	One or more Critical Drainage Areas linked together to provide a planning policy tool for the end users. Primarily defined on a hydrological basis, but can also accommodate geological concerns where these significantly influence the implementation of SuDS.
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could included 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.
Risk Management Authority	As defined by the Floods and Water Management Act 2010.
RMA	Risk Management Authority
SAB	SuDS Approving Body
Sewer Flooding	Flooding caused by a blockage or lack of capacity leading to sewer water overflowing from a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, including the public and communities
SuDS	Sustainable Drainage Systems
Sustainable	Methods of management practices and control structures that

Term	Definition
Drainage Systems	are designed to drain surface water in a more sustainable manner than some conventional techniques.
Surface Water	Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.
SWMP	Surface Water Management Plan
UKCP09	United Kingdom Climate Projections 2009
WAG	Welsh Assembly Government
WBC	Warrington Borough Council

Contents

1	Introduction.....	1
1.1	Study Area	1
1.2	What is Surface Water?	2
1.3	What is a Surface Water Management Plan?	3
1.4	Background to this Study	3
1.5	Scope of the Study.....	4
1.6	SWMP Objectives	4
2	New Legislation, Duties and Local Flood Risk Management	5
2.1	Flood and Water Management Act	5
2.2	Flood Risk Regulations and Preliminary Flood Risk Assessments	5
2.3	Strategic Land Use Policy	6
2.3.1	PPS 1: Delivering Sustainable Development	6
2.3.2	PPS 25: Development and Flood Risk	6
2.4	Local Planning Policy	8
2.5	The National flood and coastal risk management strategy for England ..	8
2.6	Local Flood Risk Management Strategy	9
2.7	Strategic Flood Risk Assessments.....	9
3	Responsibilities	10
3.1	Delivery of Local Flood Risk Management.....	10
3.2	Further Responsibilities	10
4	Stage 1 – Preparation.....	12
4.1	The Warrington SWMP Steering Group.....	12
4.2	Communication and Engagement.....	12
4.3	Data Collection and Review	13
5	Stage 2 – Risk Assessment.....	16
5.1	Preliminary Flood Risk Assessment.....	16
5.2	Site Inspections and Risk Verification	16
5.3	Preliminary flood Risk Assessment Results.....	17
5.4	Preliminary Flood Risk Assessment Summary	19
5.5	Intermediate Flood Risk Assessment.....	19
5.6	Ongoing Monitoring.....	20
6	Strategic Planning Going Forward	22
6.1	Flood Risk to Proposed Developments.....	22
6.2	SWMP Risk Assessment and Planning Decisions	22
6.3	Assessing Risk to Specific Development Sites	23
6.4	Methods for Reducing Surface Water Flood Risk to Developments	24
6.4.1	Control the Water at Source	24
6.4.2	Designing for Exceedance.....	25
6.5	Further Information and Guidance	26

List of Tables

TABLE 1: STAGES OF THE SWMP.....	3
TABLE 2: DELIVERY OF THE LOCAL FLOOD RISK MANAGEMENT	10
TABLE 3: DEFRA RECOMMENDED DATA QUALITY SCORING SYSTEM	13
TABLE 4: DATASETS COLLECTED	14
TABLE 7: SUSCEPTIBILITY TO SURFACE WATER FLOODING CRITERIA.....	23
TABLE 8: APPLICABILITY OF DIFFERENT SUDS TECHNIQUES	25

1 Introduction

Jacobs Engineering was commissioned in autumn 2010 by Warrington Borough Council to undertake a borough wide Surface Water Management Plan; in co-operation with the Environment Agency and United Utilities to build upon a previously completed Pilot Surface Water Management Plan.

This document aims to provide further evidence regarding the extent of surface water flooding across the borough and builds upon the existing evidence base contained in Warrington's Strategic Flood Risk Assessment completed in October 2011. The findings of the Warrington Surface Water Management Plan have been used to inform this document and hence support the emerging Local Development Framework Core Strategy.

1.1 Study Area

The study area for Warrington Borough Council's Surface Water Management Plan is the administrative boundary of the Borough. (Figure 1, Appendix A)

The Borough of Warrington covers some 176km² (68mi²) and is situated in the North West of England between Manchester and Liverpool. At mid-2005, it had an estimated population of 194,700, with the town of Warrington being by far the largest settlement in the Borough, with a population of over 160,000 and providing jobs for some 80,000 people.

This in part reflects over 20 years of planned growth following its designation as a new town in 1968. The study area covers the whole of Warrington, from Winwick in the north to Appleton in the south and from the outskirts of Lymm in the east to Fiddler's Ferry in the west.

The Borough has extensive areas of high-grade agricultural land, a varied landscape character and important areas of nature conservation value, mostly within the relatively narrow gaps of open land separating Warrington from urban areas to the west, north and east. The area is generally flat and below 20m AOD with low-lying land within the Mersey floodplain.

The average annual rainfall in the WBC area is approximately 600mm which is reasonably distributed throughout the year with an average low of 40mm in May and an average peak of 69mm in October.

Two significant waterways cross the main urban area; the River Mersey which passes close to the town centre and further south, the Manchester Ship Canal. Various small urban watercourses drain to the River Mersey in a roughly north south direction.

The River Mersey is tidal with the normal tidal limit being at Howley weir in the centre of the town of Warrington. The Manchester Ship Canal runs through Warrington having split off from the River Mersey at Bollin Point. Upstream from Warrington the Manchester Ship Canal receives flow from the River Mersey at Irlam and the Rivers Irwell, Irk and Medlock in Manchester. The total catchment area draining into the Manchester Ship Canal upstream of Bollin Point covers an area of approximately 1,965km².

There are three other canals present within the study area, in addition to the Manchester Ship Canal. These are the Bridgewater Canal and the New Cut Canal, owned by the Manchester Ship Canal Company, and the St Helens Canal, owned by Warrington Borough Council.

The water company that serves the administrative area is United Utilities.

1.2 What is Surface Water?

Surface water flooding is defined in DEFRA's SWMP technical guidance as:

- Surface water runoff; runoff as a result of high intensity rainfall 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);
- Flooding from groundwater where groundwater is defined as all water which is below the surface of the ground and in direct contact with the ground or subsoil.
- Sewer flooding*; flooding which occurs when the capacity of underground systems is exceeded due to heavy rainfall, resulting in flooding inside and outside of buildings. Note that the normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters** as a result of wet weather or tidal conditions;
- Flooding from open-channel and culverted watercourses which receive most of their flow from inside the urban area and perform an urban drainage function;
- Overland flows from the urban/rural fringe entering the built-up area, and;
- Overland flows resulting from groundwater sources.

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

**Interactions with larger rivers and tidal waters can be important mechanisms controlling surface water flooding

1.3 What is a Surface Water Management Plan?

A Surface Water Management Plan (SWMP) studies the risk from surface water flooding and sets out a framework for managing the risk now and in the future.

As recommended by the DEFRA Surface Water Management Plan Technical Guidance (March 2010), the SWMP has been progressed in a series of distinct stages as shown in Table 1. The results from each stage have influenced the work that was carried out in the later stages.

TABLE 1: STAGES OF THE SWMP

SWMP Stage	Tasks
Stage 1 – Preparation	<ul style="list-style-type: none">• Establish SWMP Partnership• Gather and collate flood risk data
Stage 2 – Risk Assessment	<ul style="list-style-type: none">• Assess the risk from surface water flooding across the study area
Stage 3 – Prepare Action Plan	<ul style="list-style-type: none">• Assess potential measures for managing flood risk now and in the future• Draw up the Action Plan, a framework for carrying out further investigations and actions to manage flood risk
Stage 4 – Implement Action Plan	<ul style="list-style-type: none">• Carry out the measures identified in the Action Plan

1.4 Background to this Study

In 2008, DEFRA published Future Water, the Government's strategy for sustainable delivery of secure water supplies and an improved and protected water environment. This included a specific consultation on surface water drainage in order to determine policies for more effective and sustainable management of surface water. SWMPs were proposed as the tools for assessing surface water in critical drainage areas with improved stakeholder participation, to give surface water management a stronger role in coordinating development and investment planning.

The Pitt Review (Sir Michael Pitt, October 2008); was carried out in response to the extensive flooding nationwide during the summer of 2007, a large component of which was due to surface water flooding.

A series of recommendations were put forward to improve flood risk management in the future, including recommending that local authorities, with the support of relevant organisations and guidance by the Environment Agency and DEFRA, should have the main responsibility for surface water planning and management as they have the greatest understanding of the local issues. Most of the Pitt Review recommendations for future flood management have been enacted through the Flood and Water Management Act 2010 (covered in section 2.1).

SWMPs were also recommended as the tools for local authorities to help manage all local flood risk.

1.5 Scope of the Study

This report builds on previous studies undertaken by the Council regarding flood risk.

1.6 SWMP Objectives

The SWMP Partnership (Covered in Section 3) agreed the key objectives of the SWMP project. These are to:

- Produce a Surface Water Management Plan for Warrington with an ongoing framework for delivery.
- Agree arrangements for ongoing collection, assessment and storage of flood risk information that is required for the ongoing delivery and management of the SWMP.
- Provide a methodology and summary of the systems used for data analysis, storage, sharing and reviewing at appropriate frequencies to support flood risk management duties.
- Provide and establish a robust evidence base of flood risk from surface water that will support and inform Warrington's Local Flood Risk Management Strategy, Preliminary Flood Risk Assessment and Strategic Flood Risk review requirements.
- Provide a series of GIS layers that illustrate the surface water flood risk areas, showing depths and velocities, and a methodology for keeping the maps and data up to date.
- Provide a methodology for the prioritisation of risk areas from surface water flooding.
- Provide a range of appropriate flood risk mitigation measures that can be considered to assist with managing surface water flood risk in Warrington.
- Provide a methodology for detailed investigation procedures that would be appropriate for analysing in more detail the surface water flood risk in Warrington.
- Provide an assessment of the future consequences of surface water flood risk for Warrington.

2 New Legislation, Duties and Local Flood Risk Management

2.1 Flood and Water Management Act

The Flood and Water Management Act 2010 (FWMA) presents a number of challenges for policy makers and the flood and coastal risk management authorities identified to co-ordinate and deliver local flood risk management (surface water, groundwater and flooding from ordinary watercourses). ‘Upper Tier’ local authorities (Lead Local Flood Authorities – LLFA) have been empowered to manage local flood risk through new responsibilities for flooding from surface and groundwater.

As a Unitary Authority Warrington Borough Council is a Lead Local Flood Authority.

The FWMA reinforces the need to manage flooding holistically and in a sustainable manner. This has grown from the key principles within Making Space for Water (Defra, 2005) and was further reinforced by the summer 2007 floods and the Pitt Review (Cabinet Office, 2008). It implements several key recommendations of Sir Michael Pitt’s Review of the summer 2007 floods, whilst also protecting water supplies to consumers and protecting community groups from excessive charges for surface water drainage.

2.2 Flood Risk Regulations and Preliminary Flood Risk Assessments

The FWMA must also be considered in the context of the EU Floods Directive, which was transposed into law by the Flood Risk Regulations 2009 (the Regulations - FRR) on 10 December 2009. The Regulations require three main types of assessment / plan:

- Preliminary Flood Risk Assessments - PFRA (maps and reports for Sea, Main River, Reservoirs and Localised flooding) to be completed by Lead Local Flood Authorities and the Environment Agency by the 22 December 2011. Localised flooding includes flooding from other relevant sources such as surface water, groundwater and ordinary watercourses (including lakes and ponds). Flood Risk Areas, at potentially significant risk of flooding from any of these sources, will also be identified. Maps and management plans will be developed on the basis of these flood risk areas.
- Flood Hazard Maps and Flood Risk Maps. The Environment Agency and Lead Local Flood Authorities are required to produce Hazard and Risk maps for the Flood Risk Areas identified in the PFRA by 22 December 2013. Of the ten indicative Flood Risk Areas that have been identified nationally, none are located within Warrington’s administrative area.

- Flood Risk Management Plans. The Environment Agency and Lead Local Flood Authorities are required to produce Flood Risk Management Plans for the Flood Risk Areas identified in the PFRA by 22 December 2015.

In June 2011, Warrington Borough Council submitted the PFRA to the Environment Agency, which benefited from an increased level of information from the SWMP. Councils will need to review PFRAs every 6 years.

2.3 Strategic Land Use Policy

The land use planning process is driven by a whole host of policy and guidance at a national level. Whilst the majority of these policies are not aimed at mitigating flood risk, there are key links at all operational levels between land use and spatial planning, and flood risk management (FRM) planning, which should be considered as part of a planned and integrated approach to delivering sustainable development

2.3.1 PPS 1: Delivering Sustainable Development

PPS1 sets out the overarching planning policies on the delivery of sustainable development through the planning system. It sets out how Local Planning Authorities (LPAs) should prepare policies to avoid new development in areas of flood risk and sea level rise, and take climate change impacts into account in the location and design of development.

PPS1 provides for Local Development Documents to adopt a spatial planning approach that goes beyond traditional land use planning and which does not replicate, cut across or detrimentally affect matters within the scope of the other legislative requirements (e.g. the Building Regulations). The accompanying policy statement "Planning and Climate Change" provides an expanded policy on planning's contribution to mitigating and adapting to climate change.

2.3.2 PPS 25: Development and Flood Risk

The aim of PPS25 is to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at highest risk.

In March 2010, Communities and Local Government (CLG) published a revised version to PPS25, which clarifies some aspects of the existing national spatial planning policy on development and flood risk, to help ensure the policy is applied effectively.

The key planning objectives of PPS25 relevant to Warrington BC are that LPAs should prepare and implement planning strategies that help to deliver sustainable development by:

- Identifying land at risk and the degree of risk of flooding from river, sea and other sources in their areas;
- Preparing Strategic Flood Risk Assessments (SFRAs) as appropriate, as a freestanding assessment that contributes to the Sustainability Appraisal of their plans;
- Framing policies for the location of development which avoid flood risk to people and property where possible, and manage any residual risk, taking account of the impacts of climate change;
- Only permitting development in areas of flood risk when there are no suitable alternative sites in areas of lower flood risk and the benefits of the development outweigh the risks from flooding;
- Safeguarding land from development that is required for current and future flood management e.g. conveyance and storage of flood water, and flood defences;
- Reducing flood risk to and from new development through location, layout and design, incorporating sustainable drainage systems (SUDS);
- Using opportunities offered by new development to reduce the cause and impacts of flooding e.g. surface water management plans; making the most of the benefits of green infrastructure for flood storage, conveyance and SUDS; re-creating functional floodplain; and setting back defences;
- Working effectively with the Environment Agency, other operating authorities and other stakeholders to ensure that best use is made of their expertise and information so that plans are effective and decisions on planning applications can be delivered expeditiously; and
- Ensuring spatial planning supports flood risk management policies and plans, River Basin Management Plans and emergency planning.
- In addition to setting out the roles and responsibilities for LPAs, PPS25 identifies that landowners also have a primary responsibility for safeguarding their land and other property against natural hazards such as flooding.

Those promoting sites for development are also responsible for:

- Demonstrating that it is consistent with PPS25 and LDDs; and
- Providing a Flood Risk Assessment (FRA) demonstrating whether the proposed development: is likely to be affected by current or future flooding; satisfies the LPA that the development is safe; and identifies management and mitigation measures.

Although the SWMP process does not form part of the statutory spatial planning process, it has important links with it.

2.4 Local Planning Policy

The system of development plan production introduced by the Planning and Compulsory Purchase Act 2004 aims to simplify the process of plan preparation and encourage further community involvement.

The Local Development Framework takes the form of a portfolio of plans and documents made up of several Local Development Documents. Some of the documents will have a statutory status (Development Plan Documents) and others will be adopted as local guidance documents. LDDs can either deal with different issues or different geographical areas, but when taken together they will set out the Council's policies for how it will assess development proposals and direct future growth.

Warrington Borough Council is currently preparing their strategic planning policies through their Core Strategy. As an essential element of the pre-production and evidence gathering stage of the LDF, Warrington BC is required to consider all elements of flood risk in the borough and as such has commissioned a review of the Strategic Flood Risk Assessment to reflect significant developments in flood risk management (FRM) and its policy as well as new and updated flood risk information.

2.5 The National flood and coastal risk management strategy for England

The principal aim of the strategy is to ensure that flood risks are well managed and coordinated so that impacts of flooding are minimal.

It clarifies each of the flood risk management authorities' roles and makes it clear that there should be more power at a local level to manage flood risk (i.e. the community and the lead local flood authority).

The key themes of the document for Local Authority purposes are that, as LLFAs they:

- Need to create up-to-date risk management plans
- Have a better understanding of risks particularly from surface water and groundwater
- Raise the understanding of risk in the community
- Reduce the chance of harm by building, maintaining and improving flood risk management practices (where affordable)
- Avoid inappropriate development.
- Provide a rapid response to flood emergencies and promote faster recovery.
- Must help communities participate in flood risk management

2.6 Local Flood Risk Management Strategy

The Flood and Water Management Act 2010 requires each LLFA to produce, maintain, apply and monitor a Local Flood Risk Management Strategy for their area (no guidance has yet been produced about the details and timing for when these will need to be completed).

Whilst the SWMP does not actually produce a Local Flood Risk Management Strategy, the SWMP, PFRA and their associated risk maps will provide the necessary evidence base to support the development of this. The local strategy will build upon local studies and national risk assessments and will use consistent risk based approaches across different local authority areas and catchments.

The Local Flood Risk Management Strategy required under the Flood and Water Management Act 2010 falls under the scope of the Strategic Environmental Assessment Directive (2001/42/EC). This is implemented in the UK by 'The Environmental Assessment of Plans and Programmes Regulations 2004 (Statutory Instrument No.1633)'. Its objective is 'to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development'.

2.7 Strategic Flood Risk Assessments

Each local planning authority is required to produce a Strategic Flood Risk Assessment – SFRA, under Planning Policy Statement 25. This provides an important tool to guide planning policies and land use decisions.

This Surface Water Management Plan is informed by the Strategic Flood Risk Assessment (SFRA). The aim of the SFRA was to provide further evidence to support the management of future surface water discharges from new developments.

The SFRA suggested policies for managing surface water flood risk across the borough and has identified a range of Critical Drainage Areas (CDAs) to illustrate particular areas which are at high risk of surface water flooding. Policies included in the SFRA suggest that in CDAs, a detailed FRA is required regardless of which flood zone that applies for all developments over 0.5 hectares, and therefore in areas that are particularly sensitive to an increase in the rate of surface water runoff and/ or volume of new development due consideration is given demonstrate that the development will not adversely affect existing flooding conditions by the use of appropriate mitigation measures. The SWMP has undertaken a more detailed assessment of the risk of surface water flooding than was completed for the SFRA.

3 Responsibilities

3.1 Delivery of Local Flood Risk Management

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 LLFA, Warrington is therefore responsible for leading local flood risk management across the area.

Local flooding comes from a number of sources, as follows:

- Surface water (runoff before it enters a sewer)
- Groundwater
- Ordinary watercourses
- Canals

It is the responsibility of the LLFA to coordinate the response to flooding from these sources.

The Environment Agency remains the lead organisation responsible for managing flooding from Main Rivers and the sea. The water company remains responsible for flooding from sewers, except where it is wholly or partly caused by rainwater entering the system. Floods or raw sewage caused by blocking of a sewer for example are not covered by the regulations, neither is flooding from burst water mains. The Environment Agency, United Utilities and Warrington Borough Council are all classed as Risk Management Authorities.

Table 2 below illustrates how this SWMP fits into the delivery of the local flood risk management and where the responsibilities for this lie.

TABLE 2: DELIVERY OF THE LOCAL FLOOD RISK MANAGEMENT

Overview	DEFRA			
	Environment Agency (National Strategy)			
Planning	PFRAs	SWMPs	CFMPs	SMPs
	Lead Local Flood Authorities – Local strategies Surface Water, Groundwater, Ordinary Watercourses			
Delivery	LLFAs – Surface Water and Groundwater		EA – Main River and the Sea	
	Water companies, reservoir owners, highway authorities			
	Third Party assets			

3.2 Further Responsibilities

To assist with local delivery, there are a number of key responsibilities that have arisen for LLFAs from the FWMA and the FRR. These are summarised below.

- **Investigating flood incidents** – Section 19 of the FWMA outlines that LLFAs have a duty to investigate and record details of significant flood events within their area. This duty includes identifying which authorities have flood risk management functions and what they have done or intend to do with respect to the incident, notifying risk management authorities where necessary and publishing the results of any investigations carried out.
- **Asset Register** – Section 21 of the FWMA outlines that LLFAs also have a duty to maintain a register of structures or features which are considered to have an effect on flood risk, including details on ownership and condition as a minimum. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.
- **SuDS Approving Body** – LLFAs are designated the SuDS Approving Body (SAB) for any new drainage system, and therefore must approve, adopt and maintain any new sustainable drainage systems (SuDS) within their area.
- **Local Strategy for Flood Risk Management** – LLFAs are required to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategy will build upon information such as national risk assessments and will use consistent risk based approaches across different local authority areas and catchments.
- **Works powers** – LLFAs have powers to undertake works to manage flood risk from surface runoff and groundwater, consistent with the local flood risk management strategy for the area.
- **Designation powers** – LLFAs, as well as district councils and the Environment Agency have powers to designate structures and features that affect flooding or coastal erosion in order to safeguard assets that are relied upon for flood or coastal erosion risk management
- **Duty to Cooperate and Share information** – LLFAs, as well as other Flood Authorities (Environment Agency, Water Company, other LLFAs) have a duty to cooperate with each other, and also the power to request information, in connection with flooding, of any person or body.

4 Stage 1 – Preparation

4.1 The Warrington SWMP Steering Group

The first task undertaken for the SWMP was to establish the SWMP Partnership, bringing together Warrington Borough Council (as LLFA) and other Flood Risk Management Authorities.

The SWMP partnership was based on the existing Warrington Flood Risk Management Task Group. The partnership provides strategic direction for the SWMP project and ensures that the work undertaken is tailored to local needs and meets the objectives of the study.

The Warrington SWMP partnership comprised of the following core partners:

- Warrington Borough Council
- The Environment Agency
- United Utilities
- Jacobs (Providing technical support and assistance)

4.2 Communication and Engagement

Warrington Borough Council has been developing a Communications Strategy as the SWMP has been developed.

The purpose of this Communications and Engagement (CE) Plan is to:

- Set out the importance of good communication and engagement.
- Outline what the Plan is for, who it will be used by and how it will be implemented.
- Build on the existing draft Consultation and Engagement Strategy produced during the Warrington pilot SWMP.

Communication is important when engaging any individual or group who is, or could become, interested in, involved in or affected by, or have an effect on, the policies and activities of an organisation. More targeted and meaningful communication and engagement helps build longer-term trust with our partners, stakeholders and communities.

This CE Plan specifically focuses our communication and engagement on development of a Surface Water Management Plan (SWMP) for Warrington. It aims to ensure that people inside and outside the project team understand how communicating with our partners, stakeholders and communities is important in helping us make the right decisions for sustainably managing flood risk.

The Communication and Engagement Plan is a 'live' document and is regularly reviewed, updated and built upon to capture learning and changing circumstances.

4.3 Data Collection and Review

WBC and the other SWMP partners hold a very significant volume of data on historic, and predicted flooding. In order to ensure that all of the available data was utilised effectively it was agreed that WBC, in cooperation with, and with advice from Jacobs, would collect and collate the required data from the other project partners.

As recommended by the Defra SWMP guidance Jacobs has collated and reviewed the data to identify data gaps and where existing data is substandard, or contains significant uncertainty.

The Defra guidance recommends that data is assessed based upon a number of criteria, shown in Table 3.

TABLE 3: DEFRA RECOMMENDED DATA QUALITY SCORING SYSTEM

Data Quality Score	Description	Explanations	Example
1	Best Possible	No better available, not possible to improve in the near future	High resolution LiDAR River/ sewer flow data Rain gauge data
2	Data with known deficiencies	Best replaced as soon as possible	Typical sewer or river model that is a few years old
3	Gross Assumptions	Based on experience and judgement	Location, extent and depth of much surface water flooding Operation of unmodelled highway drainage Future risk inputs e.g. rainfall, population
4	Heroic Assumptions	An educated guess	Ground roughness for 2d models

Data from the following authorities and organisations has been used in the preparation of this PFRA:

- Environment Agency
- Water Company (United Utilities)
- Manchester Ship Canal Company
- Cheshire Fire and Rescue Service

TABLE 4: DATASETS COLLECTED

Owner	Dataset	Description	Confidence Rating
Environment Agency	Areas Susceptible to Surface Water Flooding (AStSWF)	The first generation national mapping, outlining areas of risk from surface water flooding across the country with 3 susceptibility bandings.	2
	Flood Map for Surface Water (FMfSW)	The updated (second generation) national surface water flood mapping which was released at the end of 2010. this dataset includes two flood events (with a 1 in 30 and a 1 in 200 chance of occurring in any given year) and two depth bandings.	2
	Flood Map (Rivers & Sea)	Shows the extent of flooding from rivers with a catchment of more than 3km ² and from the sea.	2
	Areas Susceptible to Groundwater Flooding (AStGwF)	Coarse scale national mapping showing areas which have a high probability of groundwater emergence.	3
	National Receptor Database (NRD)	A national dataset of social, economic, environmental and cultural receptors including residential properties, school, hospitals, transport infrastructure and electricity substations.	2
	Indicative Flood Risk Areas	Nationally identified flood risk areas, based on the definition of 'significant' flood risk described by DEFRA & WAG.	2
	Historic Flood Map (HFM)	Attributed spatial flood extent data for flooding from all sources.	3
	Mersey Estuary Catchment Flood Management Plan (CFMP)	CFMP's consider all types of inland current and future flooding, from rivers, groundwater, surface water and tidal flooding and are used to plan and agree the most effective way to manage flood risk in the future.	2
Warrington Borough Council	Historic Flooding Records	Historic records of flooding from surface water, groundwater and ordinary watercourses.	3
	Anecdotal information relating to local flood history	Anecdotal information from authority officers regarding areas known to be susceptible from all sources of flooding	4
	Strategic Flood Risk Assessment Level 1	The Stage 1 SFRA focuses on collecting information regarding all sources of flooding. This helps to identify the spatial distribution of flood risk sources in Warrington	3
	Strategic Flood Risk Assessment Level 2 Draft	The Stage 2 SFRA focuses on the details nature of flood hazard taking into account the presence of flood risk management measures such as flood defences and the location of key development and regeneration areas in Warrington.	2
	Critical Infrastructure dataset	Contains information of WBC critical infrastructure.	2
	Water Cycle Strategy	The Water Cycle Strategy identifies the water services infrastructure that is needed to support and enable sustainable development in the mid Mersey area.	2
	Surface Water Management Plan Flood Depth Mapping	Surface Water Flood Modelling conducted as part of the SWMP stage 2.	2
	Surface Water Management Plan Stage Interim Reports	Information on future surface water flood risk is outlined in these documents.	2

Warrington Borough Council
Surface Water Flooding Evidence Base (May 2012) Final 04

Owner	Dataset	Description	Confidence Rating
United Utilities	DG5 Register	DG5 Registers logs and records of sewer flooding incidents for each area.	2
Cheshire Fire & Rescue	Incident Response Register	Issue logs of all events recorded by Cheshire Fire and Rescue Service. This includes internal floods such as burst pipes and sewerage problems.	2

5 Stage 2 – Risk Assessment

5.1 Preliminary Flood Risk Assessment

In order to ensure that the activities undertaken for the SWMP were as targeted, and as efficient as possible with more detailed assessment in areas of greater risk, a rapid screening process of the entire WBC area was undertaken, following the completion of the data collection exercise.

The Preliminary Risk Assessment consists of a series of activities to gain a greater understanding of the level of risk:

- Collation of the Environment Agency ‘Areas Susceptible to Surface Water Flooding’ (AStSWF) and the ‘Flood Map for Surface Water’ (FMfSW), along with WBC, Fire & Rescue, and United Utilities historic instances of flooding.
- GIS-based ‘dry mapping’ of potential flow-paths and ponding areas using the Digital Terrain Model.
- Site inspections and risk verification.

The GIS-based dry mapping of potential flow-paths and ponding areas using the Digital Terrain Model identifies routes by which water might flow across the ground, following the shape of the terrain. It also identifies ‘hollows’ with no low level outlet, which water would flow into and pond to a certain depth.

This exercise provides a useful comparison to the AStSWF and FMfSW as it identifies specific flow-paths and localised ponding areas that the EA national mapping is unable to represent as precisely. The technique is also capable of providing information on the depth of potential ponding areas, and the slope and accumulating area of flow-paths. This allows an approximate estimation of the velocity along flow-paths and potential maximum depth in ponding areas, and consequently the potential hazard to people from flooding in different areas. It must be remembered however that the dry mapping is purely GIS based and does not represent likely actual surface flows or ponding during a specific extreme rainfall event – only the flow routes and ponding areas. Nevertheless it is a very useful component in preparing composite maps because of the detail it can provide.

5.2 Site Inspections and Risk Verification

Whilst analysis of the above mapping and observed data can provide a strategic overview of risk across the whole of the WBC area, the assessment is only as good as the data that it is based on. In particular, the technique used by the EA to ‘filter’ out manmade objects, such as bridges, from the Digital Terrain Model may not always be effective. Large ponding areas can be generated upstream of

bridges, which appear in the Digital Terrain Model as blocks to flow, if the flowpath link is large and has not been effectively represented, when in fact water would flow under the bridge without ponding.

It is therefore helpful to verify the findings of the initial screening and mapping process by carrying out a series of site inspections. These can be invaluable in identifying likely flooding mechanisms and possible mitigation measures. Importantly, they can also be used to undertake a preliminary assessment of the level of food risk at flood incident locations and hotspot areas determined from the initial composite mapping. Site inspections were undertaken on the 6th and 7th of December 2010 by the Jacobs SWMP team. 30 sites were inspected across Warrington in total.

These site visits assessed the sites to confirm the presence of flowpaths and ponding areas and gauged their likely effects; for example the number of properties likely to be affected; the depth of flooding; and the velocity of flows.

5.3 Preliminary flood Risk Assessment Results

The Warrington SWMP study area is predominantly flat, sitting as it does on the wider floodplain of the River Mersey. The ground rises slightly to the south of the Mersey but the gain in elevation is very small, and there are no particularly steep slopes.

This means that flooding resulting from pluvial flows running down major flowpaths is not common, and that the majority of flooding results from direct pluvial ponding, which can be extensive, or as a result of the incapacity of sewers and highway drainage systems to convey surface runoff away during extreme pluvial events. The flat nature of the topography means that it can be difficult for the surface water to drain away effectively as may happen on more sloping topography. This relatively shallow ponding can occur extensively in many small discrete areas or in some cases much larger areas.

These flooding issues have the potential to be very widespread during and after large rainfall events, particularly where shallow depressions work to contain and concentrate flood waters. However, whilst flooding of this kind may impact on a large number of people it is unlikely that very deep flood depths and high velocity flows, that might represent a significant hazard to people, will occur.

Due to the generally flat nature of the terrain, the micro-topography, such as road cambers and kerb heights, and property threshold levels are likely to play a significant role in determining the extent and impacts of flooding. The threshold levels of individual properties in particular are likely to have a significant influence on the economic damages resulting from flood events.

In some cases flooding issues may also be highly localised, affecting only a small number of properties. These flooding incidents are unlikely to be predicted by the EA national mapping, due to the scale at which this assessment is carried out, and many may not be detectable unless there is previous flooding history or more detailed modelling is undertaken.

It is also likely that, in some areas, there will be complex interactions between different flooding sources which may exacerbate the level of risk; in particular fluvial flooding from rivers (which can also be influenced by tidal levels), and sewer flooding.

Fluvial flooding can directly exacerbate pluvial flood risk during severe rainfall events by causing inundation of floodplain areas as a result of high river levels. This has the potential to dramatically increase both flood depths and velocities and may represent a significant risk to life. In culverted watercourse systems intense rainfall events can overwhelm the capacity of the culvert and result in surcharging of water through manholes. As development has often occurred on top of culverted watercourses this can result in significant depths, and high velocity flows, running through properties as the water follows the natural topographic flow-path.

High water levels in watercourses can also indirectly impact pluvial flood risk by inhibiting the free drainage of surface water through underground drainage systems, such as highway drains by 'tide-locking' these systems. If a severe rainfall event coincides with high river levels the storage capacity of the drainage system may well be overwhelmed if water is unable to drain away. This can result in surcharging and potentially flooding of roads and properties

Sewer flooding occurs when the public sewerage system is unable to cope with the amount of water produced during an extreme rainfall event. This results in surcharging of the sewer and flooding from manholes. In combined sewer systems this can result in flooding being contaminated by sewage, representing a risk to human health. Sewer flooding is relatively common in Warrington due to the flat topography and shallow hydraulic gradients within the sewers. United Utilities are currently undertaking major works in the Penketh area with the aim of alleviating sewer flooding issues.

It should be noted that, whilst works to improve the public sewer network may help alleviate pluvial flooding it is unlikely that any drainage system would be large enough to cope with very extreme events (with occurrence probabilities of perhaps 1:100 annual probability or greater). These are still likely to result in widespread flooding of properties in ponding areas or along flow-paths.

5.4 Preliminary Flood Risk Assessment Summary

The preliminary assessment has indicated that surface water flooding in Warrington is likely to have two main characteristics:

- Large-scale, shallow ponding areas affected by widespread flooding, with the potential to affect hundreds of properties during and after very high intensity rainfall events.
- Small-scale, localised flooding issues, likely to affect few properties but potentially occurring with much greater frequency

5.5 Intermediate Flood Risk Assessment

To improve our understanding of when and where surface water flooding occurs, and what impacts the flooding is likely to have; four computer models were built representing the main urban areas within Warrington Borough: (Model coverage is shown in Figure 2, Appendix A)

- Warrington North – the majority of central Warrington between the Manchester Ship Canal and the M62 Motorway
- Warrington South – the urban areas of Warrington south of the Manchester
- Ship canal, including Lymm
- Burtonwood
- Culcheth

The models were created using the TUFLOW package, a two dimensional modelling program that represents the terrain through a grid. Rain is simulated onto the surface of the modelled terrain and is then allowed to run off, following the slope of the ground.

To make sure that the model presents a conservative estimate of the risk from surface water flooding, no rainfall was allowed to be absorbed by the ground or flow into the urban drainage system. However, flooding from the urban drainage system was represented in the models, by including the volumes of water flooding out of individual manholes as the drainage system reaches capacity. This information had previously been modelled by United Utilities.

The results of the Strategic Risk Assessment modelling give a much better understanding of the risk of surface water flooding within the modelled areas. The models tell us:

- How frequently an area is likely to flood – different rainfall events, with different probabilities that they might occur, were simulated using the model. These range from small, common events (with a 1 in 2 (50%) chance of occurring in any year, to large, infrequent events, with a 1 in 200 (0.5%) chance of occurring in any year.

- How deep the flooding is likely to be for a given event.
- How fast the water is likely to be flowing during a given event.
- Whether the flooding in a given event might represent a risk of injury or death to people affected.
- What economic damages could be expected, on average, each year into the future.

As the modelled data does not cover the whole of the Warrington Borough area, the modelled data has been combined with a national surface water flood risk map created by the Environment Agency.

In order to assist with strategic planning decisions, the SWMP Intermediate modelling assessment results have been merged with the Environment Agency Areas Susceptible to Surface Water Flooding (AStSWF) map to produce a Warrington SWMP Surface Water Flood Map. This map covers the whole of the Warrington BC area and identifies areas at low to high susceptibility to surface water flooding, based upon the methodology used to create the EA national AStSWF map.

As previously identified, this map is designed to assist with the strategic assessment of surface water flood risk to proposed new developments and dictates the requirements of flood risk assessments for proposed development areas, in a similar way to the Environment Agency National Fluvial Flood Map.

The map is not designed to assess in detail the level of risk within a development and if a site requires a FRA further assessment of the level of surface water flood risk will be required.

The mapping produced as part of the Intermediate Flood Risk Assessment can be viewed in Appendix A (Figure 3).

5.6 Ongoing Monitoring

The partnership arrangements established as part of the SWMP process will continue under the umbrella of the Flood Risk Management Task Group beyond the completion of the SWMP in order to discuss the implementation of the proposed actions, review opportunities for operational efficiency and to review any legislative changes.

The SWMP Action Plan should be reviewed and updated once every six years as a minimum, but there may be circumstances which might trigger a review and/or an update of the action plan in the interim, for example:

- Occurrence of a surface water flood event;
- Additional data or modelling becoming available, which may alter the understanding of risk within the study area;

- Outcome of investment decisions by partners is different to the preferred option, which may require a revision to the action plan, and;
- Additional (major) development or other changes in the catchment which may affect the surface water flood risk.

The modelled outputs will be updated as new more detailed information/data becomes available.

6 Strategic Planning Going Forward

6.1 Flood Risk to Proposed Developments

The intermediate modelling undertaken produced an assessment of the potential future risk of surface water flooding, taking into account climate change. This assessment simulates a flooding event with a 1% chance of occurring in any year, using an estimate of the rainfall in the year 2050, assuming a high degree of climatic change resulting from no reduction in future greenhouse gas emissions. The modelled scenario indicates that the risk of surface water flooding is likely to increase in the future due to an increase in the frequency and intensity of extreme rainfall events. However, it is unlikely that the characteristics of the surface water flooding will change significantly, with flooding across the Burtonwood, Culcheth and Warrington South models remaining dominated by major flow-paths and flooding across Warrington North being characterised by widespread shallow flooding. It is likely that future development on the potential development sites could significantly alter the land use, and potentially the local topography, of the sites. Future development proposals on sites identified as being at risk from surface water flooding should undertake more detailed assessment of the potential surface water flood risk, taking into account the proposed development, including any changes to ground permeability and proposed drainage systems, in line with current planning policy.

6.2 SWMP Risk Assessment and Planning Decisions

The SWMP risk assessment has been undertaken on a strategic scale, considering the risk of surface water flooding across the borough. The risk assessment is therefore suitable for gaining a broad understanding of surface water flood risk to potential development areas, and the likely impact that new development will have on surface water flood risk in surrounding areas. This information should be used to form part of the evidence base when assessing development sites and determining requirements for preparing Site Specific Flood Risk Assessments (FRAs).

When using this information on surface water flood risk, reference should also be made to the existing Warrington Level 2 SFRA, which contains further information on considering flood risk from all sources of flooding, including surface water, when planning new development. The information in this document does not supersede the information contained in the SFRA but is designed to enhance it, using the up-to-date information prepared as part of the SWMP.

6.3 Assessing Risk to Specific Development Sites

The SWMP modelling undertaken for the strategic risk assessment should be used to identify the potential susceptibility to surface water flooding of a proposed development site. This indicates areas that could flood during or after an intense rainfall event. A description of the susceptibility criteria is shown in Table 7.

TABLE 7: SUSCEPTIBILITY TO SURFACE WATER FLOODING CRITERIA

Susceptibility	Description
Low	These areas represent potential surface water flow paths or ponding areas but are only likely to be affected by surface water flooding during rainfall events. These areas will flood last, after areas that are considered more susceptible to flooding.
Intermediate	These areas are potentially at risk from flowing or ponding surface water flooding. These areas will flood only after areas highly susceptible to flooding.
High	These areas are highly susceptible to flooding from surface water which may occur frequently during or after extreme rainfall events. These areas will flood first and flooding is likely to be most prolonged.

It should be noted that the Strategic Flood Risk Assessment modelling does not identify site specific factors, such as micro-changes in topography that can significantly impact on surface water flood risk within a site.

According to Planning Policy Statement 25 (PPS25):

“Local topography and built form can have a strong influence on the direction and depth of flow. The design of development down to a micro-level can influence or exacerbate this.”

It will therefore be necessary for proposed development sites of 0.5 hectares or greater and at Intermediate or High risk from surface water flooding (refer to the SWMP Flood Risk Maps in Appendix A) to undertake a Site Specific Flood Risk Assessment, following the guidelines laid out in PPS25 and in the SFRA.

This assessment will be required even if they fall within Environment Agency Flood Zone 1 and the FRA should demonstrate that new development is not at risk from flooding from existing drainage systems, or potential overland flow

routes. It should also demonstrate that the development will not adversely affect existing flooding conditions by the use of appropriate mitigation measures.

Note that potential development sites in Flood Zone 1, categorised as being at Low Susceptibility to surface water flooding will still have to prepare a FRA if the site area is greater than 1 hectare, in line with PPS25. All sites falling within Flood Zones 2 and 3 will still be required to prepare FRAs.

6.4 Methods for Reducing Surface Water Flood Risk to Developments

There are a large number of methods for reducing the level of surface water flood risk posed to developments. The PPS25 Practice Guide advocates considering site specific surface water flood risk management in two stages:

- Stage 1 - control the water at source through sustainable drainage systems (SUDS).
- Stage 2 - consider exceedance i.e. what flow-paths will be taken by excess surface water ('the major drainage system') when the capacity of the drainage system is exceeded.

6.4.1 Control the Water at Source

The Flood and Water Management Act 2010 makes it mandatory for developers to consider the use of Sustainable Urban Drainage System (SUDS) for managing surface water runoff. SUDS mimic natural drainage and reduce the amount and rate of water flow into the surface water drainage system by:

- Allowing water to infiltrate naturally into the ground (these are 'Infiltration SUDS');
- Holding water in storage areas (these are 'Storage SUDS'), and;
- Slowing the flow of water into the urban drainage network (these are 'Conveyance' SUDS).

There are a number of SUDS techniques which could be used individually or as part of a wider option within a proposed site. However, their suitability is dependant upon site factors, for example ground permeability, and their intended purpose. Table 8 outlines the potential SUDS techniques listed in the PPS25 Practice Guide with their suitability for certain applications.

TABLE 8: APPLICABILITY OF DIFFERENT SUDS TECHNIQUES

SuDS Technique	Infiltration	Storage	Conveyance
Green Roofs	✗	✓	✓
Permeable Paving	✓	✗	✓
Rainwater Harvesting	✗	✓	✗
Swales	✓	✓	✓
Detention Basins	✓	✓	✓
Ponds	✗	✓	✓
Wetlands	✗	✓	✓

A Strategic Assessment of the potential areas where different types of SUDS will be applicable, due to different site permeability, has also been undertaken as part of the SWMP. Based upon British Geological Survey superficial geological information, Figure 4 in Appendix A indicates areas likely to have permeable ground conditions where Infiltration SUDS might be most suitable, and those areas which are likely to have impermeable ground conditions, or high ground water, where Storage SUDS are likely to be required.

Note that this assessment does not consider potential localised ground conditions and detailed investigation should be undertaken prior to the design of any SUDS systems.

6.4.2 Designing for Exceedance

Underground drainage systems have a finite capacity and regard should always be given to larger events when the capacity of the network will be exceeded.

Hence there is a need to design for exceedance. This should be considered alongside any surface water flows likely to enter a development site from the surrounding area. Master planning should ensure that existing overland flow paths are retained within the development.

As a minimum the developer should investigate, as part of a FRA, the likely depths and extents of surface water flooding on a development site. This is a precautionary, but an appropriate approach to reduce the risk of flooding to new developments. Green infrastructure should be used wherever possible to accommodate such flow paths. Floor levels should always be set a minimum of 300mm above adjacent roads to reduce the consequences of any localised flooding.

The effectiveness of a flow management scheme within a single site is heavily limited by site constraints including (but not limited to) topography, geology (soil permeability), development density, existing drainage networks within the site and surrounding area, adoption issues and available area. The design,

construction and ongoing maintenance regime of such a scheme must be carefully defined at an early stage and a clear and comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential.

6.5 Further Information and Guidance

The Warrington Level 2 SFRA contains further information on planning proposed developments to reduce the risk of flooding from all sources. When planning and designing SUDS, reference should be made to the CIRIA SUDS Manual and connected publications.