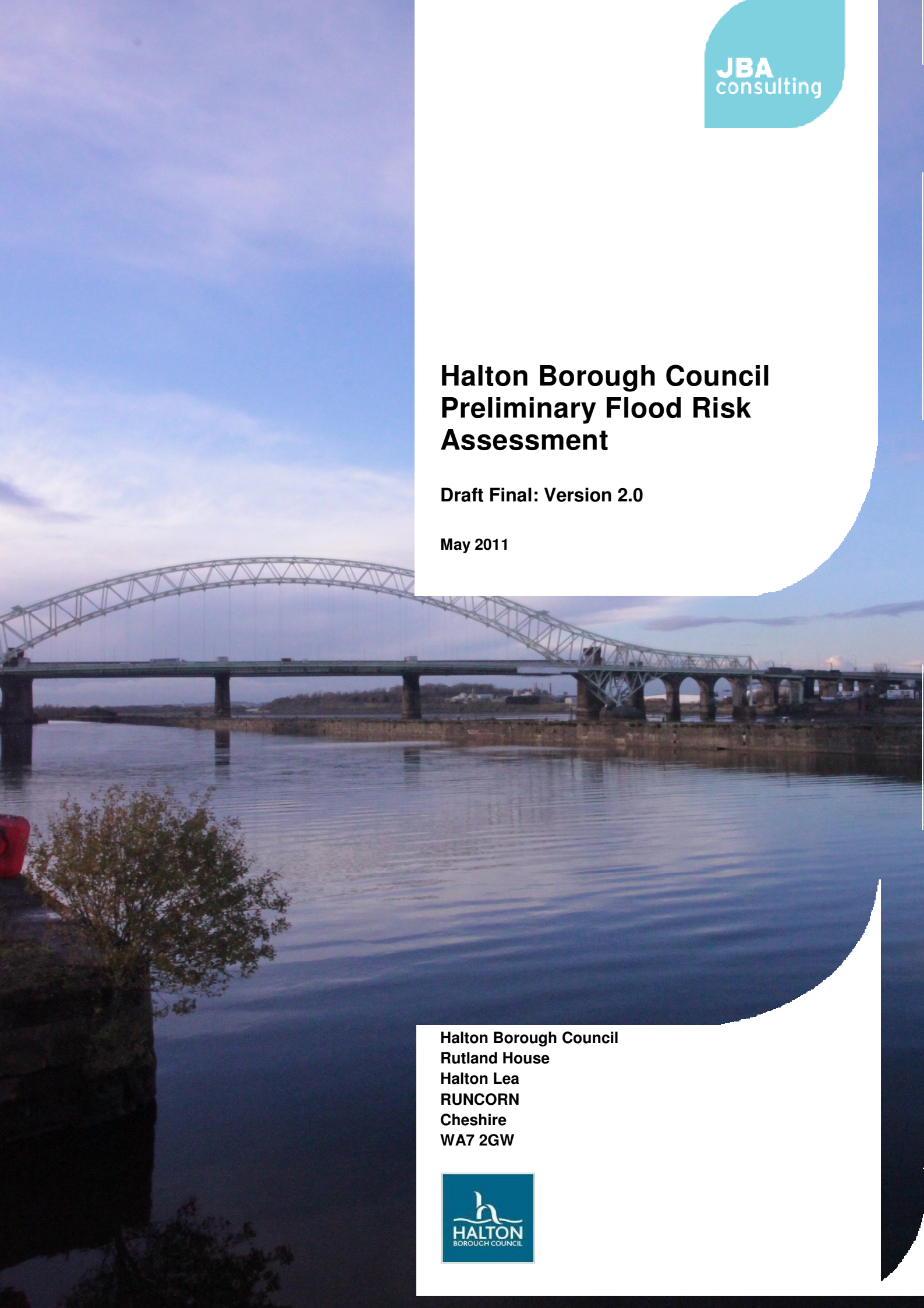

Halton Borough Council Preliminary Flood Risk Assessment

Draft Final: Version 2.0

May 2011

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
Draft v1.0 (April 2011)		Dave Cunliffe (Halton Borough Council)
Draft Final v2.0 (May 2011)	Text alterations following meeting with HBC on Friday 13th May 2011	Dave Cunliffe (Halton Borough Council)

Contract

This report describes work commissioned by Dave Cunliffe, on behalf of Halton Borough Council, by a letter dated 31st January 2011. Halton Borough Council's representative for the contract was Dave Cunliffe. Howard Keeble and Rosalind Whitham of JBA Consulting carried out this work.

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Purpose

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Executive Summary

Introduction

As a LLFA, Halton Borough Council must submit their PFRA to the Environment Agency for review by 22nd June 2011. The methodology for producing this PFRA is based on the Environment Agency's Final PFRA Guidance and Defra's Guidance on selecting Flood Risk Areas, both published in December 2010.

In order to ensure a consistent national approach, Defra identified significance criteria and thresholds to be used for defining flood risk areas. The Environment Agency then used these criteria with their own national datasets to determine indicative Flood Risk Areas. Ten national Indicative Flood Risk Areas were identified; of which one very small element encroaches within the Halton Council area.

In order to develop a clear overall understanding of the flood risk across Halton, this report collates and reviews all available local flood risk information of past and future flood risk. The majority of this data was sourced from Halton's Strategic Flood Risk Assessment.

Based on the evidence that was collected, "no past flood events were considered to have had nationally significant harmful consequences". Therefore, the decision was made to not include any records of past flooding in Annex 1 of the Preliminary Assessment Spreadsheet.

However, it should be noted that there remains a risk of flooding from local sources across Halton, particularly from surface water. Based on the Environment Agency's national surface water modelling approximately 9,700 residential properties and 2,900 non-residential properties are estimated to be at risk from flooding to a depth of 0.3m during a rainfall event with a 1 in 200 annual chance of occurring. This does however not meet the Environment Agency national threshold of 30,000 people within a cluster of significant areas required to identify a Flood Risk Area.

Based on the information currently available, it is therefore concluded that Halton Council does not have the information required to justify or support the inclusion of a Flood Risk Area within their administrative boundary.

By not having a Flood Risk Area covering Halton Council, the next stage of the PFRA process is not triggered. This means the Council does not have to produce flood hazard maps, flood risk maps and flood risk management plans for that area. Halton Council will, however, still have to produce a local flood risk management strategy for their area. The approach taken by Council's outwith an FRA is essentially the same. Whilst it does not have to be done to prescribed deadlines in the Regulations a strategic approach will be required to assessing and developing solutions to reduce flood risk.

Flood Risk in Halton

Halton is at risk from many different sources of flooding including, main rivers, Ordinary Watercourses, surface water runoff, groundwater, sewer flooding and the residual risks associated with artificial water bodies such as the Bridgewater Canal, the Manchester Ship Canal and reservoirs.

Background

JBA Consulting was commissioned by Halton Borough Council to undertake a Preliminary Flood Risk Assessment on completion of their Level 2 SFRA, prepared in accordance with current best practice, Planning Policy Statement 25 Development and Flood Risk (PPS25)1 and the PPS25 Practice Guide2 and completed in 2011.

[1] Communities and Local Government (2006) Planning Policy Statement 25: Development and Flood Risk
[2] Communities and Local Government (2008) Planning Policy Statement 25: Development and Flood Risk – Practice Guide

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Abbreviations

1D	One-Dimensional
2D	Two-Dimensional
ABD	Area Benefiting from Defence
AEP	Annual Exceedance Probability
ASTSWF	Areas Susceptible to Surface Water Flooding
BAP	Biodiversity Action Plan
CFMP	Catchment Flood Management Plan
CLG	Communities and Local Government
COW	Critical Ordinary Watercourse
CRR	Community Risk Register
CSO	Combined Sewer Overflow
Defra	Department of Environment, Food and Rural Affairs
DPDs	Development Plan Documents
DTM	Digital Terrain Model
EA	Environment Agency
EC	European Commission
EU	European Union
FCERM	Flood and Coastal Erosion Risk Management
FEH	Flood Estimation Handbook
FMfSW	Flood Map for Surface Water
FRA	Flood Risk Assessment
FRR	Flood Risk Regulations
FRM	Flood Risk Management
FWMA	Flood & Water Management Act
GIS	Geographical Information Systems
HBC	Halton Borough Council
IUD	Integrated Urban Drainage
JFLOW	A 2D flood model which solves depth averaged fluid flow equations to model the movement of water over the ground
LDDs	Local Development Documents
LDF	Local Development Framework
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
LoSA	Level of Service Agreement
LPAs	Local Planning Authorities
LRF	Local Resilience Forum
MAOD	Metres Above Ordnance Datum
MoU	Memorandum of Understanding
MSC	Manchester Ship Canal
MSCC	Manchester Ship Canal Company
NFCDD	National Flood and Coastal Defence Database
NRD	National Receptor Dataset
PFRA	Preliminary Flood Risk Assessment
PPL	People
PPS	Planning Policy Statement
RFRA	Regional Flood Risk Assessment
RBD	River Basin District
RFDC	Regional Flood Defence Committee
RBMP	River Basin Management Plans
RPB	Regional Planning Body
RPG	Regional Planning Guidance
SAB	SUDS Approving Body
SA	Sustainability Appraisal
SAC	Special Areas of Conservation

SCI	Statement of Community Involvement
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SIRS	Sewerage Incident Recording System
SMP	Shoreline Management Plan
SoP	Standard of Protection
SPA	Special Protection Areas
SSSIs	Sites of Special Scientific Interest
SUDS	Sustainable (Urban) Drainage Systems
SWMP	Surface Water Management Plan
UDP	Unitary Development Plan
UU	United Utilities
WAG	Welsh Assembly Government
WCS	Water Cycle Study
WFD	Water Framework Directive
WIRS	Wastewater Incident Recording System

Glossary

Annual exceedance probability

The estimated probability of a flood of given magnitude occurring or being exceeded in any year. Expressed as, for example, 1 in 100 chance or 1 per cent Annual Exceedance Probability (AEP).

Areas Susceptible to Surface Water Flooding

A surface water flood event that results from rainfall generated overland flow before the runoff enters any watercourse or sewer. Usually associated with high intensity rainfall (typically >30mm/hr) resulting in overland flow and ponding in depressions in the topography, but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has low permeability. Urban underground sewerage/drainage systems and surface watercourses may be completely overwhelmed, preventing drainage. Surface water flooding does not include sewer surcharge in isolation.

Catchment Flood Management Plans (CFMP)

A strategic planning tool through which the Environment Agency will seek to work with other key decision-makers within a river catchment to identify and agree policies for sustainable flood risk management.

Climate change

Long-term variations in global temperatures and weather patterns, both natural and as a result of human activity.

DG5 register

Register held by water companies on the location of properties at risk of flooding from public sewers

Flood Map

A map produced by the Environment Agency providing an indication of the likelihood of flooding within all areas of England and Wales, assuming there are no flood defences. Only covers river and sea flooding.

Flood Map for Surface Water

The 2nd generation surface water mapping is called the 'Flood Map for Surface Water' were developed in March 2009 following a tender and evaluation process we employed JBA Consulting (working in partnership with Halcrow) to develop the 2nd generation maps.

This included a number of improvements to the original model in areas where it was known to be weaker; for example considering:

- more storm events;
- the influence of buildings;
- the influence of the sewer system.

In terms of the classification of these layers, for each rainfall probability, the map provides two shapefiles which can be used individually to indicate:

- 'Surface Water Flooding' (flooding greater than 0.1m deep)
- 'Deeper Surface Water Flooding' (flooding greater than 0.3m deep);

Flood and Water Management Act

The Flood and Water Management Act[3] received Royal Assent on 8th April 2010. The Act creates unifying legislation covering all forms of flooding and shifting the emphasis from building defences to managing risk.

Flood Risk Regulations

The Flood Risk Regulations transpose the EU Floods Directive into UK law and were introduced on 10 December 2009. These confirm the lead local flood authority role and require specific tasks to be undertaken by these authorities this year, with completion of Preliminary Flood Risk Assessments and identification of Flood Risk Areas due by June 2011.

Flood Map

The Flood Map shows the areas across England and Wales that could be affected by flooding from rivers/from the sea/from rivers and, or the sea. It also shows flood defences and the areas that benefit from certain defences. Flood Map is designed to raise awareness among the public, local authorities and other organisations of the likelihood of flooding, and to encourage people living and working in areas prone to flooding to find out more and take appropriate action.

Flood Zone

A geographic area within which the flood risk is in a particular range, as defined within PPS25.

Flood Zone 1

Zone 1 covers areas with the lowest probability of flooding from rivers and the sea, where the chance of flooding in any one year is less than 0.1% (i.e. a 1000 to 1 chance).

Flood Zone 3

The Environment Agency's best estimate of the areas of land with a 1% (1 in 100), or greater, chance of flooding each year from rivers, or with a 0.5% (1 in 200) chance, or greater, of flooding each year from the sea.

Flood Zone 2

The Environment Agency's best estimate of the areas of land between Zone 3 and the extent of the flood from rivers/from the sea/from rivers and, or the sea with a 0.1% (1 in 1000) chance of flooding in any year.

Fluvial

Flooding caused by overtopping of rivers or stream banks.

[3] http://www.defra.gov.uk/environment/flooding/policy/fwmb/key-docs.htm

FRiL-MX

JBA Consulting's software which allows detailed analysis of the impacts of flooding in an ArcGIS9 environment. It requires predicted flooding depths from different flood modelling scenarios, reflecting levels of flood risk management or frequency of flood event. The depth grids are queried against different receptor data and simple spatial and graphical visualisations of the impacts are generated.

Historic Flood Map

Historic Flood Map is the maximum extent of all recorded individual Historic Flood Events Outlines from river, the sea and groundwater springs and shows areas of land that have previously been subject to flooding in England & Wales.

JBA Consulting's Enhanced Surface Water Flood Mapping

This mapping forms part of the JBA Comprehensive Flood Map. The data comprises of five flood perils; Fluvial (defended and undefended), Coastal (defended), Surface Water, Groundwater and Dam Break. Data are available for mainland UK and a number of annual exceedance probabilities have been derived for each flood peril using the latest in-house software JFLOW-GPU and JFLOW+. The JFLOW modelling software range are 2D hydraulic models that are designed for broad scale modelling.

JFLOW

JFLOW (developed by JBA) is a 2D flood model which solves depth averaged fluid flow equations to model the movement of water over the ground.

Local Development Framework (LDF)

A non-statutory term used to describe a folder of documents which includes all the Local Planning Authority's Local Development Documents (LDDs). The Local Development Framework will also comprise the statement of community involvement, the local development scheme and the annual monitoring report.

Local Development Documents (LDDs)

All development plan documents which will form part of the statutory Local Development Framework (LDF), as well as supplementary planning documents which do not form part of the statutory development plan.

Main River

A watercourse designated on a statutory map of Main Rivers, maintained by Defra, on which the Environment Agency has permissive powers to construct and maintain flood defences (and powers to control development).

National Receptor Dataset

The National Receptor Dataset (NRD) is a collection of risk receptors primarily intended for use in flood and coastal erosion risk management. It is available for use by Local Planning Authorities, the Environment Agency and our contractors.

Ordinary watercourse

All rivers, streams, ditches, drains, cuts, dykes, sluices, sewers (other than public sewer) and passages through which water flows which do not form part of a Main River. Local authorities and, where relevant, Internal Drainage Boards have similar permissive powers on Ordinary Watercourses, as the Environment Agency has on Main Rivers.

Outline

The extent of flooding for any particular flood source.

Planning Policy Statement (PPS)

A statement of policy issued by central Government to replace Planning Policy Guidance notes.

Receptor

A subset of the property point dataset where the flooding flag =1 (and any other required attributes such as MCMCode to select properties of a certain type). It may be easier/preferable to select subsets of the property points feature class in advance.

Reservoir (large raised)

A reservoir that holds at least 10,000 cubic metres of water above natural ground level, as defined by the Flood and Water management Act (2010).

Return period

The long-term average period between events of a given magnitude which have the same annual exceedance probability of occurring.

Risk

The threat to property and life as a result of flooding, expressed as a function of probability (that an event will occur) and consequence (as a result of the event occurring).

Strategic Flood Risk Assessment (SFRA)

The assessment of flood risk on a catchment-wide basis for proposed development in a Local Planning Authority area.

Sustainable Drainage Systems (SUDS)

A sequence of management practices and control structures, often referred to as SUDS, designed to drain water in a more sustainable manner than some conventional techniques. Typically these are used to attenuate run-off from development sites and involve infiltration to ground wherever feasible.

Water Framework Directive (WFD)

A European Community Directive (2000/60/EC) of the European Parliament and Council designed to integrate the way water bodies are managed across Europe. It requires all inland and coastal waters to reach “good status” by 2015 through a catchment-based system of River Basin Management Plans, incorporating a programme of measures to improve the status of all natural water bodies.

1. Introduction

1.1 Scope of the Report

This Preliminary Flood Risk Assessment (PFRA) provides Halton Council with a means of fulfilling their obligations under the European Floods Directive. The aim of the Directive is to reduce and manage the risks that floods pose to human health, the environment, economic activity and cultural heritage.

The Flood Risk Regulations (FRR), which came into force on the 10th December 2009, and the Flood & Water Management Act, which gained Royal Assent on the 8th April 2010, form the basis for this PFRA.

The purpose of the FRR is to implement the European Floods Directive (Directive 2007/60/EC) on the assessment and management of flood risk) into domestic law in England and Wales.

The aim of the Directive is to reduce the likelihood and consequence of flooding by establishing a common framework for understanding and managing flood risk across Europe. It establishes four stages of activity within a six year flood risk management cycle.

All Unitary Authorities, and in two-tier systems all County Councils, are designated as a Local Lead Flood Authority (LLFA) and have formally been allocated a number of key responsibilities for local flood risk management.

The European Floods Directive is implemented by the Flood Risk Regulations 2009, which sets out a flood risk management strategy, consisting of four stages:

1. The production of a Preliminary Flood Risk Assessment report;

2. Identification of Flood Risk Areas;

3. Production of appropriate Flood Hazard and Flood Risk Maps and,

4. Preparing Flood Risk Management Plans.

This Preliminary Assessment Report is the first of the two stages in the process. This report also provides the evidence and appraisal for the second stage of identifying Flood Risk Areas. The identification of Flood Risk Areas will establish where the final two stages of preparing hazard and risk maps and flood risk management plans are required.

The PFRA (and any subsequent maps and plans) will form part of the local flood risk management strategy that Halton Council is required to prepare under the FWMA. This report marks the first stage of this process which is set to take place over a cyclical six year period, the outcome of which being to provide evidence for the identification of Flood Risk Areas (stage 2). The PFRA makes use of existing and available data, and focuses on local flood risk sources such as flooding from surface water, groundwater and ordinary watercourse rather than that originating solely from the sea or main rivers.

Table 1-1 shows the elements of work required from Halton Council under the Regulations, along with the timescales of their respective delivery.

Table 1-1 Work Required under the Flood Risk Regulations 2009

Timescale	Assessment or Plan	Description
22nd June 2011	Prepare a **preliminary assessment report**	The PFRA should focus on local flood risk from **surface water, groundwater, Ordinary Watercourses and canals**.
22nd June 2011	Determination and identification of **flood risk areas**	Flood Risk Areas are areas of **significant risk** identified on the basis of the findings of the PFRA, national criteria set by the UK Government Secretary of State and guidance provided by the Environment Agency.
22nd June 2013	Prepare **flood hazard maps and flood risk maps** in relation to each relevant flood risk area	The hazard and risk maps will show the **likely extent, depth, direction, speed of flow and probability** of possible floods and their **consequences**.
22nd June 2015	Prepare a **flood risk management plan** in relation to each relevant flood risk area	The flood risk management plans will set out what the **risk management objectives** are, the measures proposed to achieve those objectives and how the measures are to be implemented.

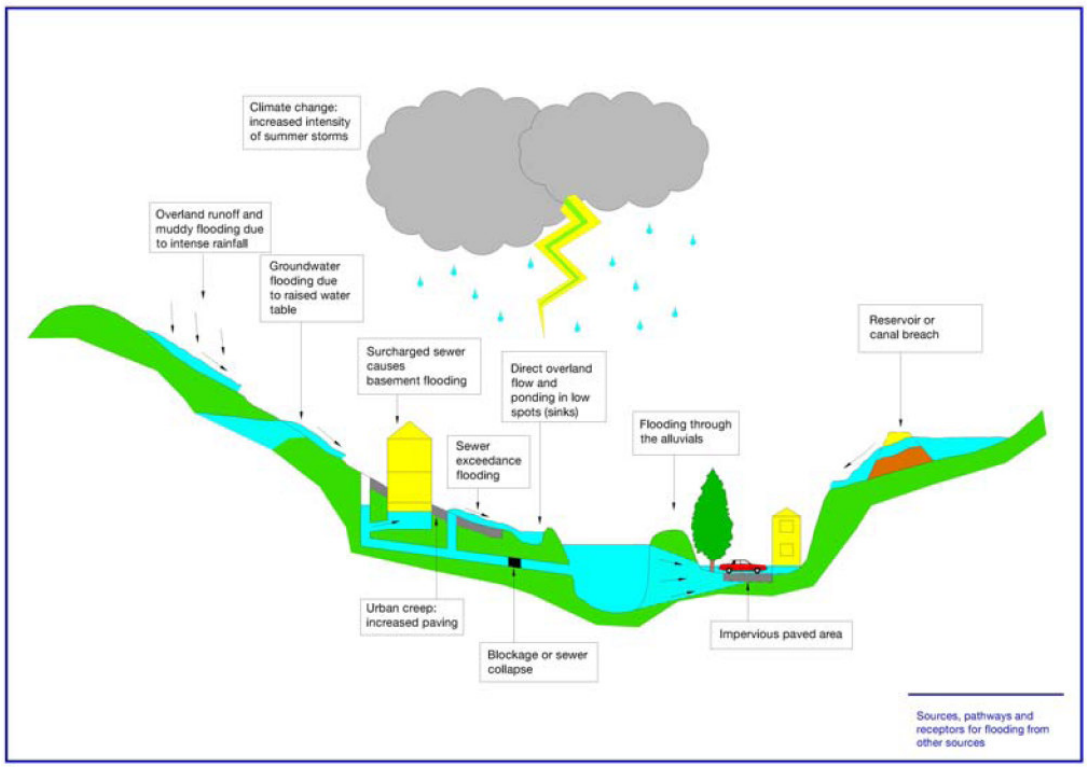
The PFRA provides a useful source of reference for future local flood risk management strategies, informing the production of flood hazard and flood risk maps (stage 3), and contributing to the preparation of future flood risk management plans (stage 4); due for completion under the Flood Risk Regulations by 2013 and 2015 respectively.

1.1.1 Flood Sources Identified

As described in the FRR, flooding associated with the sea, main rivers and reservoirs is the responsibility of the Environment Agency (EA).

LLFAs are responsible for assessing risk from surface runoff, groundwater and Ordinary Watercourses and any interaction these have with drainage systems and other sources of flooding including sewers. The interaction of flooding from main rivers, the sea and reservoirs with local sources will need to be taken into account.

Figure 1-1 Flooding from Local Sources



Descriptions of relevant sources in relation to Halton are provided below:

Surface Water Flooding

Flooding of land from surface water runoff is usually caused by intense rainfall that may only last a few hours. The resulting water follows natural valley lines, creating flow paths along roads, through and around developments and ponding in low spots, which often coincide with fluvial floodplains in low-lying areas. Surface water flooding occurs when heavy rainfall exceeds the capacity of local drainage networks and water flows across the ground.

Groundwater flooding

Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from abnormal 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.

There are several mechanisms which produce groundwater flooding including prolong rainfall raising groundwater levels, high in bank river levels, artificial obstructions and groundwater rebound.

Sewer flooding

Foul sewers and surface water drainage systems interconnect the various urban areas of Halton to treatment works and into local watercourses.

Typically, foul systems will comprise a network of drainage sewers, sometimes with linked areas of separate and combined drainage, all discharging to sewage treatment works. Combined Sewer Overflows (CSOs) provide an overflow release from the drainage system into local watercourses or surface water systems during times of high flows. Surface water systems will typically collect surface water drainage separately from the foul sewerage and discharge directly into watercourse. However, extensive areas of Widnes currently discharge to combined systems.

A major cause of sewer flooding is often due to large rainfall events causing sewers to surcharge, highways flooding and sometimes internal sewer flooding to properties.

Canal flooding

There are three main canals in the borough of Halton:

- The Bridgewater Canal is a broad canal that was initially built to serve the growing industrial centres of the North West during the Industrial Revolution. It is a fairly shallow canal that is embanked in places and mainly used today for tourism, carrying narrow boats and other small craft. The Bridgewater Canal is the responsibility of the Bridge Water Canal Company.
- The St Helens Canal (or Sankey Canal) ran for around 15 miles from St Helens in Lancashire to Widnes in Cheshire, with short branches to Blackbrook and Gerrard's Bridge. It was a broad canal with 7 single locks and two 2-rise staircase locks as well as two tidal locks onto the Mersey estuary. The canal was closed in stages by 1963 as trade died off. The Sankey Canal Restoration Society is seeking to re-open the canal.
- The Manchester Ship Canal was built by canalising sections of the lower River Irwell and River Mersey in the late nineteenth century to allow large ships to dock in Manchester City Centre. The Manchester Ship Canal is managed by the Manchester Ship Canal Company with water levels in the canal being carefully monitored and controlled by a system of sluices.

Ordinary watercourse flooding

There are a number of Ordinary Watercourses in Halton. The majority of these have been identified in the Halton SFRA. Flooding of watercourses is associated with the exceedance of channel capacity during higher flows. The process of flooding on watercourses depends on a number of characteristics associated with the catchment including; geographical location and

variation in rainfall, steepness of the channel and surrounding floodplain and infiltration and rate of runoff associated with urban and rural catchments.

Interaction with main rivers

Flooding is a natural process and does not respect political demarcations or administrative boundaries; it is influenced principally by the natural elements of rainfall, tides, geology, topography, rivers and streams and man-made interventions such as flood defences, roads, buildings, sewers and other infrastructure. As was seen in the summer of 2007, flooding can cause massive disruption to communities, damage to property and possessions.

1.2 Aims and Objectives

The overall aim of the PFRA is to provide evidence for the identification of Flood Risk Areas within Halton. It is intended that the report will also help to inform local strategies by providing a useful source of reference for all future local flood risk management. The analysis uses existing and available information and is intended to promote governance and partnership working, as well as information sharing within the LLFA areas wherever possible, so that efficient flood risk management strategies are developed.

The key objectives can be summarised as follows:

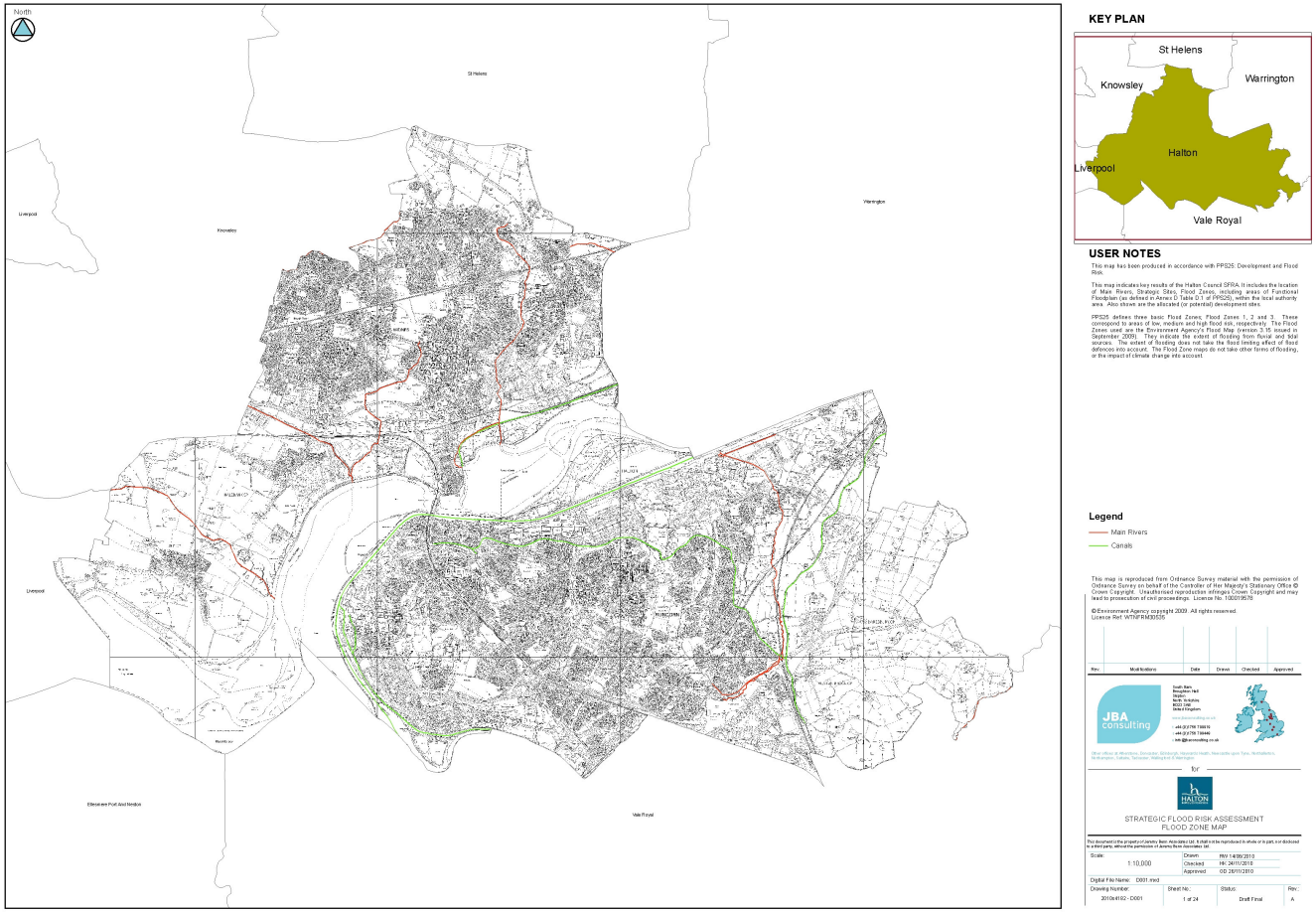
- Identify relevant partner organisations involved in future assessment of flood risk, and summarise means of future and ongoing stakeholder engagement;
- Describe arrangements for partnership and collaboration for ongoing collection, assessment and storage of flood risk data and information;
- Provide a summary of the systems used for data sharing and storing, and provision for quality assurance, security and data licensing arrangements;
- Summarise the methodology adopted for the PFRA with respect to data sources, availability and review procedures;
- Assess historic flood events within the study area from local sources of flooding (including flooding from surface water, groundwater and Ordinary Watercourses), and the consequences and impacts of these events;
- Establish an evidence base of historic flood risk information, which will be built up on in the future and used to support and inform the preparation of Halton's Local Flood Risk Strategy;
- Assess the potential harmful consequences of future flood events within the study area;
- Review the provisional national assessment of indicative Flood Risk Areas provided by the Environment Agency and provide explanation and justification for any amendments required to the Flood Risk Areas.

1.3 Study Area

Halton covers some 90km² and is situated in the North West of England between Warrington and Liverpool. According to the latest population estimate, released by the Office for National Statistics (ONS) and based on the 2009 mid year population estimates, gives a population for the borough of 118,700. The study area of the PFRA covers the whole of Halton, from Barrow's Green in the north to Weston in the south, and the outskirts of Daresbury in the east to Hale in the west.

Two waterways, the tidal River Mersey and Manchester Ship Canal, divide the main urban area. In addition three large urban watercourses, Bowers, Ditton and Keckwick Brooks drain into the River Mersey. Responsibility for maintaining these Main Rivers rests with the Environment Agency. Peel Holdings is a responsible for the Ship Canal.

Figure 1-2 Halton BC PFRA Area



2. Lead Local Flood Authority Responsibilities

2.1 Introduction

The Flood Risk Regulations define new responsibilities for flood risk management based on the recommendations of the Pitt Review. These new responsibilities are also enshrined in the Flood and Water Management Act 2010. Key responsibilities and definitions are summarised in

Table 2-1 below:

Table 2-1 Flood Risk Responsibilities

Level of Flood Risk	Organisation	Responsibilities
National Flood Risk	Environment Agency	Responsible for Main Rivers, the Sea and Reservoirs (greater than 25,000 cubic metres; may reduce to 10,000 cubic metres under provisions in the Flood & Water Management Act 2010).
Local Flood Risk	Lead Local Flood Authority	Responsible for: All other forms of flood risk (e.g. surface water, groundwater, Ordinary Watercourses, small reservoirs etc).

2.2 Coordination of Flood Risk Management

It was a recommendation of the Pitt Review that "the role of local authorities should be enhanced so that they take on responsibility for leading the co-ordination of flood risk management in their areas". As the designated LLFA, Halton Borough Council is responsible for leading local flood risk management across Halton.

Halton Borough Council will need to work closely with District and adjacent Borough Councils as well other partner organisations to ensure effective and consistent management of local flood risk.

As Lead Local Flood Authority, it is the role of Halton Borough Council to develop effective partnerships with all stakeholders including United Utilities, the Manchester Ship Canal Company and the Environment Agency. Ideally these arrangements should be formalised to ensure clear lines of communication, mutual co-operation and management through the provision of Level of Service Agreements (LoSA) or Memorandums of Understanding (MoU).

In order to assist with this, Halton Borough Council has identified the lead policy and performance board with an executive board member. The Council is also developing a number of panels, steering groups, partnerships and working groups across the organisation. Halton Council is a member of the sub-regional flood management group comprising East and West Cheshire Councils, Warrington Council, St Helen's Council and the Environment Agency.

2.2.1 Governance and Partnership

As the Lead Local Flood Authority (LLFA), Halton Council are responsible for all local flood risk within the borough. This includes flooding which primarily originates from Ordinary Watercourses, surface water and groundwater sources, however the interactions between all sources of flooding; such as from main rivers and the tidal Mersey must also be taken into consideration due to the potential impact that they may have on local flood risks. This consideration includes tide locking of rivers and surface water outfalls.

Partnership working is of the highest importance during the PFRA process. It is essential that all stakeholders such as the Environment Agency and United Utilities are involved so that a clear understanding of flood risk, and management measures, can be developed in the borough.

Halton Council, as the LLFA, to take the lead in bringing together all parties and promote partnership working. As part of this PFRA, Halton Council have chaired meetings with the Environment Agency and United Utilities.

2.3 Communication and Stakeholder Engagement

As mentioned in Section 2.1, communication with partners takes place in the form of partnership meetings to discuss roles and responsibilities. These meetings are lead by Halton Council as the LLFA and aim to provide an opportunity to brief the partnership members' on progress with ongoing work. Partnership attendance at strategic study progress meetings is undertaken to gain valuable input to decision making.

Communication with the public is achieved primarily through the Halton Borough Council website. The Council is currently developing a communication and development plan for flood risk issues, in relation to the Surface water management Plan.

As part of the PFRA, Halton Council has sought to engage stakeholders representing the following organisations, authorities and various sector/department leads within Halton Council:

- Environment Agency
- Cheshire Fire & Rescue Service
- United Utilities
- British Waterways
- Highways Agency
- Manchester Ship Canal Company
- Halton Council Spatial Planning
- Halton Council Emergency Planning
- Halton Council Highway Maintenance & Drainage

Halton Council's Strategic Flood Risk Assessment also included substantial stakeholder consultation, including with emergency planning, strategic planning, highways, drainage and parks departments and the knowledge gained in its preparation has been used to inform this PFRA.

2.4 Public Engagement

It is recognised that members of the public may also have valuable information to contribute to the PFRA and to local flood risk management more generally across Halton. Stakeholder engagement can afford significant benefits to local flood risk management including building trust, gaining access to additional local knowledge and increasing the chances of stakeholder acceptance of options and decisions proposed in future flood risk management plans.

It is important to undertake some public engagement when formulating local flood risk management plans (if a Flood Risk Area has been identified) as this will help to inform future levels of public engagement. If no Flood Risk Area has been identified, Halton Council should still engage with the public during the formulation of local flood risk management strategies.

It is recommended that Halton Council follow the guidelines outlined in the Environment Agency's "Building Trust with Communities" document which provides a useful process of how to communicate risk including the causes, probability and consequences to the general public and professional forums such as local resilience forums. Guidance should also be provided within the Halton SWMP engagement plan.

2.5 Further Responsibilities

Aside from forging partnerships and coordinating and leading on local flood management, there are a number of other key responsibilities that have arisen for Lead Local Flood Authorities from the Flood & Water Management Act and the Flood Risk Regulations. Key responsibilities and definitions are summarised in Table 2-2 below:

The commencement date of some of these responsibilities has been extracted from a recent letter from Defra to LLFAs date 8th March 2011.

Table 2-2 Other Flood Risk Responsibilities

LLFA Responsibility	Description	Legislation Commencement
Local Strategy for Flood Risk Management	Halton Council, as a LLFA is required to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategies will build on information such as national risk assessments and will use consistent risk based approaches across different local authority areas and catchments. The local strategy will not be secondary to the national strategy; rather it will have distinct objectives to manage local flood risks important to local communities.	October 2010
Investigating Flood Incidents	Halton Council, as a LLFA has a duty to investigate and record details of significant flood events within their area. This duty includes identifying which risk management authorities have relevant flood risk management functions and how they intend to exercise, or is proposing to exercise those functions in response to the flood. The responding risk management authority must publish the results of its investigation and notify any relevant risk management authorities.	April 2011
SUDS Approving Body	The Act establishes each LLFA as a SUDS Approving Body (SAB). The SAB would have responsibility for the approval of proposed drainage systems in new developments and redevelopments, subject to exemptions and thresholds. Approval must be given before the developer can commence construction. The SAB would also be responsible for adopting and maintaining SUDS which serve more than one property, where they have been approved. Highways authorities will be responsible for maintain SUDS in public roads, to National Standards.	Expected April 2012
Works Powers	The Act provides Halton Council, as a LLFA, with powers to do works to manage flood risk from surface runoff, groundwater and on Ordinary Watercourses, consistent with the local flood risk management strategy for the area.	Implementation is planned to follow the national strategy coming into force later in the year
Designation Powers	The Act provides Halton Council, as a LLFA, with powers to designate structures and features that affect flooding or coastal erosion. The powers are intended to overcome the risk of a person damaging or removing a structure or feature that is on private land and which is relied on for flood or coastal erosion risk management. Once a feature is designated, the owner must seek consent from Halton Council to alter, remove, or replace it.	Implementation is planned to follow the national strategy coming into force later in the year
Asset Register	Halton Council, as a LLFA has 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.	April 2011

3. Methodology and Data Review

3.1 Introduction

The PFRA is a high level screening exercise used to identify areas of significant risk, based on available and readily derivable information, describing both the probability and harmful consequences of past and future flooding. The PFRA involves:

- Collecting information on past (historic) and future (potential) floods;
- Assembling the information into a preliminary assessment report; and
- Identifying Flood Risk Areas.

Under the FRR, Flood Risk Areas will require further examination and management through the production of flood risk and flood hazard maps and flood risk management plans.

This report provides the evidence required to identify Flood Risk Areas. It also includes the information and decisions made by Halton Council in identifying Flood Risk Areas allowing one reference document to be produced.

The approach for producing this PFRA was based upon the Environment Agency¨s PFRA Final Guidance, which was released in December 2010.

The Flood Risk Regulations require that the activities involved in the PFRA are repeated on a 6 year cycle. It will, therefore, be necessary to maintain data for future use and to support other flood risk assessments such as Halton Council's Surface Water Management Plan (SWMP) and Strategic Flood Risk Assessment (SFRA). This reinforces further the benefit of establishing work practices and frameworks that provide long-term efficiencies, avoid repetition of effort and prevent abortive work.

The following methodology has been used to undertake the PFRA.

3.2 Methodology

Halton Borough Council has gathered information on past and future floods from a range of available or readily derivable sources. This data collection process has mainly been carried out during the preparation of the Halton Level 1 and Level 2 Strategic Flood Risk Assessments (SFRA) and the emerging Surface Water Management Plan (SWMP).

Some of the information used in the production of the PFRA is limited to specific locations or by availability, whilst other information will be part of large national datasets obtained from the Environment Agency.

3.2.1 Assessing Historic Flood Risk

Existing datasets, reports and anecdotal information from the stakeholders listed above were collected during the Halton SFRA. This was provided for the purpose of the PFRA in spreadsheet format, providing details of major past flood events and associated consequences including economic damage, environmental and cultural consequences and impact on the local population.

Each historical flood record was geo-referenced making it possible to display this information using GIS software and overlay layers to identify the spatial distribution of historic flood events and relate these datasets to receptor information, in order to assess the overall flood risk.

The PFRA process has been used as an opportunity to summarise all information available on past floods and not just those with significant consequences. In addition all historical records have been included in the summary map(s), table and description of past flooding. Although not required by the FRR, this information will inform Halton's local strategy.

3.2.2 Assessing Future Flood Risk

If a location does not have a recorded history of past floods, it does not mean that there is no risk of flooding. To ensure flood risk is assessed objectively, the PFRA should consider where flooding might occur in the future, rather than only reacting to floods in the past.

Future floods, or future flood risk, are otherwise known as potential flooding, or potential flood risk. This definition includes predicted floods extrapolated from current conditions in addition to those with an allowance for climate change. Computer models usually produce information about future floods. The assessment of future flood risk will primarily rely on a technical review of the Environment Agency's national surface water and groundwater flood maps and the Environment Agency's national Flood Map and local surface water modelling carried out in the Halton SFRA.

The following factors were considered when assessing future flood risk across the Halton study area; topography, location of Ordinary Watercourses, location of flood plains that retain water, characteristics of watercourses (lengths, modifications), effectiveness of any works constructed for the purpose of flood risk management, location of populated areas, areas in which economic activity is concentrated, the current and predicted impact of climate change and the predicted impact of any long-term developments that might affect the occurrence or significance of flooding, such as proposals for future development.

The Detailed Counting Method Used to Assess Future Floods

Receptors at risk from flooding were counted using the method known as the "Detailed Counting Method". Typically, the receptors are subsets of a point property dataset (e.g. the National Receptor Dataset or NRD). The "Simple Counting Method" would simply select the points that intersect with the flood outline of interest. The Detailed Counting Method can be summarised as counting the property points for which the associated building footprint intersects the flood outline.

In order to create the building footprints for the NRD ppl querying, a subset of the MasterMap polygons that correspond only to buildings were selected by querying the MasterMap topography data layer against the NRD ppl data layer (i.e. it was assumed that the topography was residential where it intersected the ppl point layer). The NRD ppl was then queried against all other data in the MasterMap topography data layer (i.e. that assumed to be non-residential). For all other NRD receptor counts, the MasterMap topography data layer was queried as a whole and no differentiation was given between residential and non-residential footprints.

For fluvial outlines, the Detailed Counting method might be expected to be a few percent more than the Simple Counting method. However, for surface water outlines (particularly those that have been produced from a model that excludes water from buildings) the detailed counting method can be 2 to 10 times that of the simple counting method.

The detailed counting method was occasionally noted to overestimate the area of flood risk due inaccuracies in the MasterMap polygon boundaries within the borough but this was deemed negligible in terms of the overall risks associated with flooding in Halton.

The results of the Detailed Counting Method were fed into FRiL-MX to analyse the results in a breakdown of smaller reporting units (e.g. 1 km grid squares). The count in each grid square is the points whose corresponding building polygon intersects the flood outline (i.e. as using the detailed counting method).

3.2.3 Identifying Local Flood Risk Areas

The FRR require LLFAs to determine whether there are adverse consequence, in terms of flood risk the borough and to identify the part of the area affected by the risk i.e. the Flood Risk Area.

To achieve this, flood risk indicators will be used to determine the impacts of flooding on human health, economic activity, cultural heritage and the environment. The use of flood risk

indicators helps to develop understanding of the impacts and consequences of flooding. Key flood risk indicators are summarised in Table 3-1.

Table 3-1 Key Flood Risk Indicators

Impacts of flooding on:	Flood Risk Indicators
Human Health	Number of residential properties. Critical services (Hospitals, Police/Fire/Ambulance Stations, Schools, Nursing Homes, etc).
Economic Activity	Number of non-residential properties. Length of road or rail. Area of agricultural land.
Cultural Heritage	Cultural heritage sites (World Heritage Sites).
Environment	Designated sites (SSSIs, SACs, SPAs, etc) and BAP habitat.

3.2.4 Identifying National Flood Risk Areas

The above indicators have been selected and analysed by Defra and the Environment Agency in order to identify areas where flood risk and potential consequences exceed pre-determined thresholds. These pre-determined thresholds are:

- 200 people, or
- 20 businesses, or
- 1 critical service at risk

This assessment was carried out nationally based on 1km² grid squares, and the grid squares that exceed this criterion were identified. The next step in this national approach was to identify clusters where large concentrations of significant areas exist. In England, a cluster is made up of the union of all 3 x 3 km squares that contain five or more touching blue squares.

The clustered areas that have been identified using this methodology and exceed 30,000 people at risk of flooding have been mapped and identified as Indicative Flood Risk Areas. For further details, please refer to Defra's Guidance for selecting and reviewing Flood Risk Areas for local sources of flooding (December 2010).

As these Indicative Flood Risk Areas are only based on certain nationally available data, this report focuses on carrying out a review using local information.

3.3 PFRA Data Sources

A crucial part of a PFRA is the task of collating available and readily derivable data and information on flooding to provide an assessment of flood risk. Table 3-2 provides a list of relevant information and datasets available from key stakeholders on both historic and future flood risk.

3.3.1 Data Collection from Partner Organisations

The following authorities and organisations were identified and contacted to share data for the preparation of the PFRA; Halton Borough Council, Parish councils, United Utilities, British Waterways, JBA Consulting, the Environment Agency, the Highways Agency and Cheshire Fire and Rescue Service.

Table 3-2 catalogues the relevant information and datasets held by partner organisations and provides a description of each of the datasets.

Table 3-2 Datasets held by Partner Organisations

	Dataset	Description
Environment Agency	Areas Susceptible to Surface Water Flooding	The first generation national mapping, outlining areas of risk from surface water flooding across the country with three susceptibility bandings (less, intermediate and more).
	Flood Map for Surface Water	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) and two depth bandings (greater than 0.1m and greater than 0.3m).
	Flood Map (Rivers and the Sea)	Shows the extent of flooding from rivers with a catchment of more than 3km2 and from the sea.
	Areas Susceptible to Groundwater Flooding	Coarse scale national mapping showing areas which are susceptible to groundwater flooding.
	National Receptor Dataset	A national dataset of social, economic, environmental and cultural receptors including residential properties, schools, hospitals, transport infrastructure and electricity substations.
	Indicative Flood Risk Areas	Nationally identified flood risk areas, based on the definition of 'significant' flood risk described by Defra and WAG.
	Historic Flood Map	Attributed spatial flood extent data for flooding from all sources.
	Weaver Gowy and Mersey Estuary Catchment Flood Management Plans (CFMPs)	Attributed spatial flood extent data for flooding from all sources. CFMPs consider all types of inland 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.
Halton Borough Council	Strategic Flood Risk Assessments (SFRA)	SFRAs may contain useful information on historic flooding, including local sources of flooding from surface water, groundwater and flooding from canals.
	Historical flooding records	Historical records of flooding from surface water, groundwater and Ordinary Watercourses.
	Highways Flooding Reports	Highways Flooding Reports for a number of locations within Halton, including analysis of the flood risk at each location.
	Historical Flood Event Photographs	See Annex 7.
	Anecdotal information relating to local flood history and flood risk areas	Anecdotal information from authority members regarding areas known to be susceptible to flooding from excessive surface water, groundwater or flooding from Ordinary Watercourses.
Cheshire Fire and Rescue Service	Historic flooding records	Records of historic flooding events from the Fire Service's call out history records including location, incident type and response given.
	Anecdotal information	Anecdotal information from each of the Station Managers regarding local flood risk hotspots in their areas.
JBA Consulting	Enhanced Surface Water Flood Map	Production of enhanced surface water flood modelling and mapping of the Halton Borough for the following probabilities: 1) 1 in 1000 annual probability of river flooding (1% – 0.1%) in any year 2) 1 in 200 annual probability of river flooding (>0.5%) in any year

		3) 1 in 75 annual probability of river flooding (>0.13%) in any year
United Utilities	DG5 Register for Halton Utilities areas	DG5 Register logs and records of sewer flooding incidents in each area.
	Sewerage Incident Recording System records (SIRS)	SIRS logs and records of sewer flooding incidents in each area.
	Wastewater Incident Recording System (WIRS)	WIRS logs and records of waste water flooding incidents in each area.
British Waterways	British Waterway's canal network	Detailed GIS information on the British Waterway's canal network, including the location of canal centrelines, sluices, locks, culverts, etc.
	Records of canal breaches and overtopping events	Records of historical canal breaches and canal overtopping events across Halton.

3.4 Data Share/ Data Storage

Flood risk data is currently stored on Halton Council's internal servers. It is intended that elements of the emerging SWMP, SFRA and PFRA will ultimately be accessible via the Council's website. Systems for data sharing within the sub-regional group of Councils are currently being explored.

3.5 Data Limitations

A brief assessment of the data collection process is included in this chapter to provide transparency with respect to the methodology. By highlighting issues identified in the data collection phase it is hoped this could serve as a catalyst to improve the collection of flood risk data in the future. A number of issues arose during the data collection process, as described below:

All data collected during the PFRA process has been recorded in a digital data register. Most data requested was good quality and accurate as expected. Whilst the majority of the datasets could be mapped geographically (GIS) helping to visualise the risk of flooding, other datasets could not be mapped reducing its quality. Historical flooding information was generally extensive. However, the extent, duration and cause of historical flooding often could not be determined from the available records.

The lack of a consistent flood data recording system across the Halton Borough, by stakeholders in general, has led to inconsistencies in the recording of flood event data. This has resulted in incomplete, or sometimes nonexistent, flood records.

To elaborate, the source of historic data originating from several data sources was often unknown. Flood records tended not to include evaluation of the impact of flooding, such as the number of properties affected. It was noted that the source and accuracy of information is difficult to record as it tended to be anecdotal rather than the result of a post flood survey. Further information on addressing this issue in the future is included in Chapter 5.

As a result of the lack of consistent flood data recording arrangements, some of the datasets collated are rather limited and it is felt that they are unlikely to fully represent the complexity of flooding in all areas, and may hinder the accurate identification of flood risk areas. Therefore, the identification of flood risk areas will always need to rely on a combination of historic data supplemented with the predicted consequences of flooding as determined by modelled analysis.

3.6 Data Quality

All deliverables of the PFRA study adhere to the data quality standards set out in 'Annex 5 – Data standards' of the Environment Agency guidance document

Data collected were subject to quality assurance measures to monitor and record the quality and accuracy of acquired information and datasets. A data quality score was given, which is a qualitative assessment based on the Data Quality System provided in the SWMP Technical Guidance document (March 2010). This system is explained in Table 3-3.

Table 3-3 Data Quality System from SWMP Technical Guidance (March 2010)

Data Quality Score	Description	Explanations	Example
1	Best available	No better available; not possible to improve in the near future	High resolution LiDAR River flow data, Rain gauge data
2	Data with known deficiencies	Best replaced as soon as new data is available	Typical sewer or river model that is a few years old
3	Gross assumptions	Not invented but based on experience and judgement	Location, extent and depth of surface water flooding
4	Heroic Assumptions	An educated guess	Ground roughness for 2d models

The use of this system provides a basis for analysing and monitoring the quality of data that is being collected and used in the preparation of the PFRA. Recording also ensures that uncertainties are recognised early and understood at a later stage.

3.7 Data security

The security of data is also a key consideration when it comes to collecting, collating and storing sensitive data. All data collected is stored on local servers which are password protected. Halton Borough Council must adhere to these data security measures to ensure that sensitive data is held in a secure manner.

3.8 Data licensing and restrictions

A summary table illustrating the restrictions on the use of this data is included in Table 3-4 below.

Table 3-4 Data Restrictions

Organisation	Restriction on Use of Data
The Environment Agency	The use of some data is restricted to Halton Borough Council and their consultants for the preparation of its preliminary flood risk assessment. The use of other data is unrestricted.
Halton Borough Council	Conditions relating to the supply of available GIS data are on the understanding that: - they are for internal use by JBA Consulting in relation to work co-ordinated by Halton Borough Council. - they must not be copied, loaned or sold to any third party without the prior permission of Halton Borough Council; - Halton Borough Council uses best efforts to ensure the currency and accuracy of supplied data, however it can not be held responsible for any omissions or inaccuracies within that data; - they must not be used for commercial gain; - the data remains the property of Halton Borough Council; - Halton Borough Council Copyright should be acknowledged on any output. - upon completion of the project all data supplied must be destroyed - data is not transferable between projects
Highways Agency	No licence agreement received.
United Utilities	Subject to the United Utilities data licence agreement, UU granted a non-exclusive and non-transferable licence to use UU Data beginning on the date upon which it was supplied.
Cheshire Fire and Rescue	No licence agreement received.
British Waterways	The use of provided data is restricted to Halton Borough Council and their consultants for the preparation of its preliminary flood risk assessment.

4. Assessing Historic Flood Risk

4.1 Introduction

Existing datasets, reports and anecdotal information from the stakeholders listed above were collated and reviewed to identify details of major past flood events and associated consequences including economic damage, environmental and cultural consequences and impact on the local population.

It was anticipated that information would be provided in a geo-referenced format. However, where this was not the case for some datasets, this data was geo-referenced where possible. This made it possible to display this information using GIS software and overlay layers to identify the spatial distribution of historic flood events and relate these datasets to receptor information, in order to assess the overall flood risk.

4.2 Overview of Historic Flooding in Halton

Flood records across Halton were collected from the data sources discussed in Table 3-2. Records of 11319 historical flood events and flooding hotspots were collected across Halton Borough Council's administrative area. A summary map highlighting the locations of these past flood events is illustrated in Figure 4-1.

These flood events came from a range of flood sources, and in many cases the source of flooding was unknown or not recorded. A summary of information specific to each source of flooding considered as part of the PFRA is included below.

4.2.1 Surface Water Flooding

Surface water flooding occurs when heavy rainfall exceeds the capacity of local drainage networks and water flows across the ground. Information on surface water flooding incidents was obtained from a number of sources, as discussed in Table 3-2. Key sources of surface water records were Halton Borough Council, Cheshire Fire and Rescue Service, the Highways Agency and the Catchment Flood Management Plans (CFMPs), which is a high-level strategic plans published by the Environment Agency that focus on flooding in major river catchments.

4.2.2 Groundwater Flooding

Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from abnormal 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.

Halton Borough Council's Contaminated Land Officer, Will Watson, confirmed that the groundwater levels in Halton have historically been artificially depressed and they are starting to rebound but there is no known risk of any aquifers within 2m of the ground surface (there is a major aquifer within the Sherwood Sandstone Group).

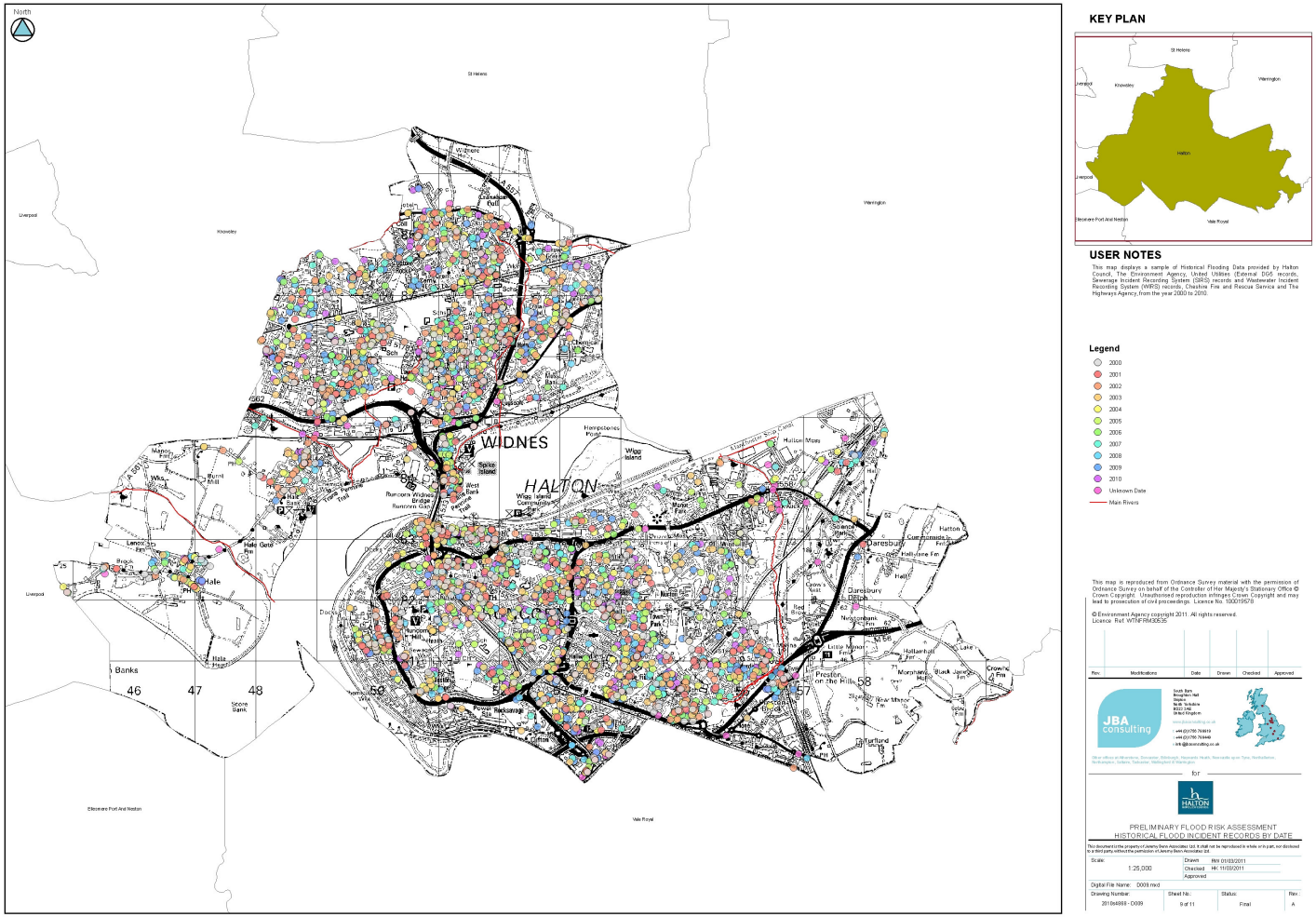
4.2.3 Sewer Flooding

Sewer flooding is often caused by excess surface water entering the drainage network. DG5 registers from United Utilities were analysed to investigate the occurrence of sewer flooding incidents across Halton County. It was found that there were a total of 49 sewer flooding events that have been recorded by the water companies between 1997 and 2004 (11 of these being internal and 38 being external). United Utilities have also recorded 9809 records in their Sewerage Incident Recording System (SIRS) between 1988 and 2008 and 1373 records in their Wastewater Incident Recording System (WIRS) between 2008 and 2010).

These records have all been georeferenced and their spatial extent and distribution can be seen in Figure 4-1.

Once a property is identified on the water companies DG5 register, it typically means that the water company can put funding in place to take properties off the DG5 register. There are no records of properties affected by sewer flooding with significant consequences within Halton.

Figure 4-1 Historical Flooding Records within Halton



4.2.4 Canal and Ordinary Watercourse Flooding

Information was obtained from the Halton Borough Council Strategic Flood Risk Assessment details the canal network throughout Halton, including the location of canals, weirs, sluices and locks. Breach analysis of raised embankments along the Bridgewater Canal modelling was undertaken as part of the SFRA.

Table 4-1 summarises locations within the study limits where interactions between watercourses and the Manchester Ship Canal and Bridgewater Canal are considered possible.

Table 4-1 Canal-river interactions

Watercourse Name	Summary
River Mersey	It is possible that embankment breach or overtopping of the Manchester Ship Canal where the watercourse runs in parallel with the River Mersey could result in additional water flowing into the river.
Sankey Brook	The Sankey Canal, (which is also known as the Sankey Brook Navigation and the St Helens Canal) runs along the valley of the Sankey Brook to the point where the brook joins the River Mersey.
Bowers Brook	The Bowers Brook runs alongside the disused St Helens Canal at Spike Island. It is possible that breach of the canal around the confluence with Bowers Brook would result in additional water flowing into the river.
Keckwick Brook and the Bridgewater Canal	It is possible that breach of the Bridgewater Canal around the confluence with Keckwick Brook at Preston Brook Marina would result in additional water flowing into the river. It is not considered possible for flow from Keckwick Brook to enter the canal at this location because of the elevation difference.
Keckwick Brook and the Manchester Ship Canal	The northern end of Keckwick Brook lies in close proximity to a Manchester Ship Canal drain at Oxmoor Lake. Embankment. It is possible that breach of the MSC around the confluence with Keckwick Brook would result in additional water flowing into the river. It is also considered possible for flow from Keckwick Brook to enter the canal drain at this location.

4.2.5 Interaction with Main Rivers and the Sea

Insufficient data was available to draw definitive conclusions at this point. However, there is anecdotal evidence to suggest that surface water flooding is exacerbated in some areas, during high tidal cycles when sewers and outfalls are blocked with high tidal waters.

4.2.6 Reservoir Flooding

Whilst the probability of dam or embankment failure is small, the consequences of such an event occurring may be significant particularly in an urban setting. The Environment Agency has recently produced simplified inundation maps for all reservoirs under the Reservoirs Act as required by Recommendation 57 of the Pitt Review.

The Reservoir Flood Map is now available from the Environment Agency website at:

www.environment-agency.gov.uk

The Outline maps have been issued on a CD to Halton Council. Discussions with Halton Council and a review of OS mapping shows there are a number of reservoirs within or upstream of the borough.

Table 4-2 identifies the main reservoirs.

Explicit consideration of reservoir overtopping and breach should be considered in detailed site-based FRAs where the reservoir is within or in close proximity to the proposed development.

Table 4-2 Key Reservoirs

Reservoir Name	Local Authority	Location
Wharford Farm Balancing Pond	Halton	Keckwick Brook, Near Runcorn
Pex Hill Reservoirs	Knowsley	East of Cronton
Fiddler's Ferry Power Station Ash Lagoons	Warrington	Fiddler's Ferry Power Station
Fiddler's Ferry Power Station Cooling Tower Ponds	Warrington	Fiddler's Ferry Power Station
Oxmoor Basin	Halton	Runcorn
Clifton Brine Reservoir	Halton	Runcorn

4.3 Analysis of Historic Flooding in Halton

Table 4-3 shows the spatial distribution of the 4436 recorded flood events throughout Halton since the year 2000 by ward. There is a large variation in the number of recorded historical flood events within each of the Halton borough wards, ranging from 381 recorded events in the Mersey ward to just 27 in the Windmill Hill ward.

Table 4-3 Distribution of Historic Flood Incident Records Since 2000 Across Halton Wards

Ward Name	Number of Historic Flood Incident Records	Ward Area in Square Miles (sq mi)	No. Incidents per sq mi
Hale	97	4.32	22.45
Heath	353	3.21	109.97
Halton Lea	247	0.82	301.22
Norton North	109	0.96	113.54
Daresbury	126	7.50	16.80
Ditton	250	3.11	80.39
Halton Castle	340	2.18	155.96
Riverside	357	2.22	160.81
Halton View	187	1.48	126.35
Farnworth	243	1.87	129.95
Mersey	381	1.39	274.10
Beechwood	114	0.52	219.23
Norton South	181	0.66	274.24
Grange	265	0.55	481.82
Windmill Hill	27	0.45	60.00
Broadheath	174	0.46	378.26
Hough Green	82	0.52	157.69
Kingsway	223	0.79	282.28
Appleton	342	0.63	542.86
Birchfield	106	0.71	149.30
Halton Brook	231	0.55	420.00

N.B. Data provided from a combination of UU (External DG5, SIRS and WIRS), Highways Agency, Cheshire Fire and Rescue Service and Halton Borough Council records.

Table 4-3 and Table 4-4, display the variability, by year, of the 4436 recorded flood events throughout Halton since the year 2000. There is a large variation in the number of recorded historical flood events, ranging from over 530 recorded events in both 2009 and 2010 and just 263 recorded events in 2004.

However, it must be noted over 100 records received did not contain an incident date and therefore the results presented should not be taken as a representation of the range in frequency or severity of flood risk across the Halton Borough Council administrative area.

Table 4-4 Distribution of Historic Flood Incident Records Since 2000 By Year

Year	Number of Historic Flood Incident Records
2000	460
2001	376
2002	413
2003	385
2004	263
2005	301
2006	305
2007	350
2008	393
2009	539
2010	535
Unknown Date	115

N.B. Data provided from a combination of UU (External DG5, SIRS and WIRS), Highways Agency, Cheshire Fire and Rescue Service and Halton Borough Council records.

4.4 Consequences of Historic Flooding

The focus of the PFRA is on national scale flooding issues rather than local flooding issue to individual property.

As a result of the issues discussed in Chapter 3 the lack of quantifiable information, in terms of the depth of flooding, duration and extent of historical events for example, means that the available information on historical is of limited use. Other than a perhaps the frequency of flooding, conclusions on the impact that historic flood events have on people, the economy and the environment cannot be readily determined.

Due to the lack of information available, no historic flood events have been considered to have had 'significant harmful consequences' and therefore none will be recorded in Annex 1 of the Preliminary Assessment Spreadsheet. However, a complete record of locations where flooding has occurred will be kept by Halton Borough Council as a future evidence base. This base will be built up in the future through ensuring full details of flood events are recorded; this will then be used to support and inform future PFRA cycles.

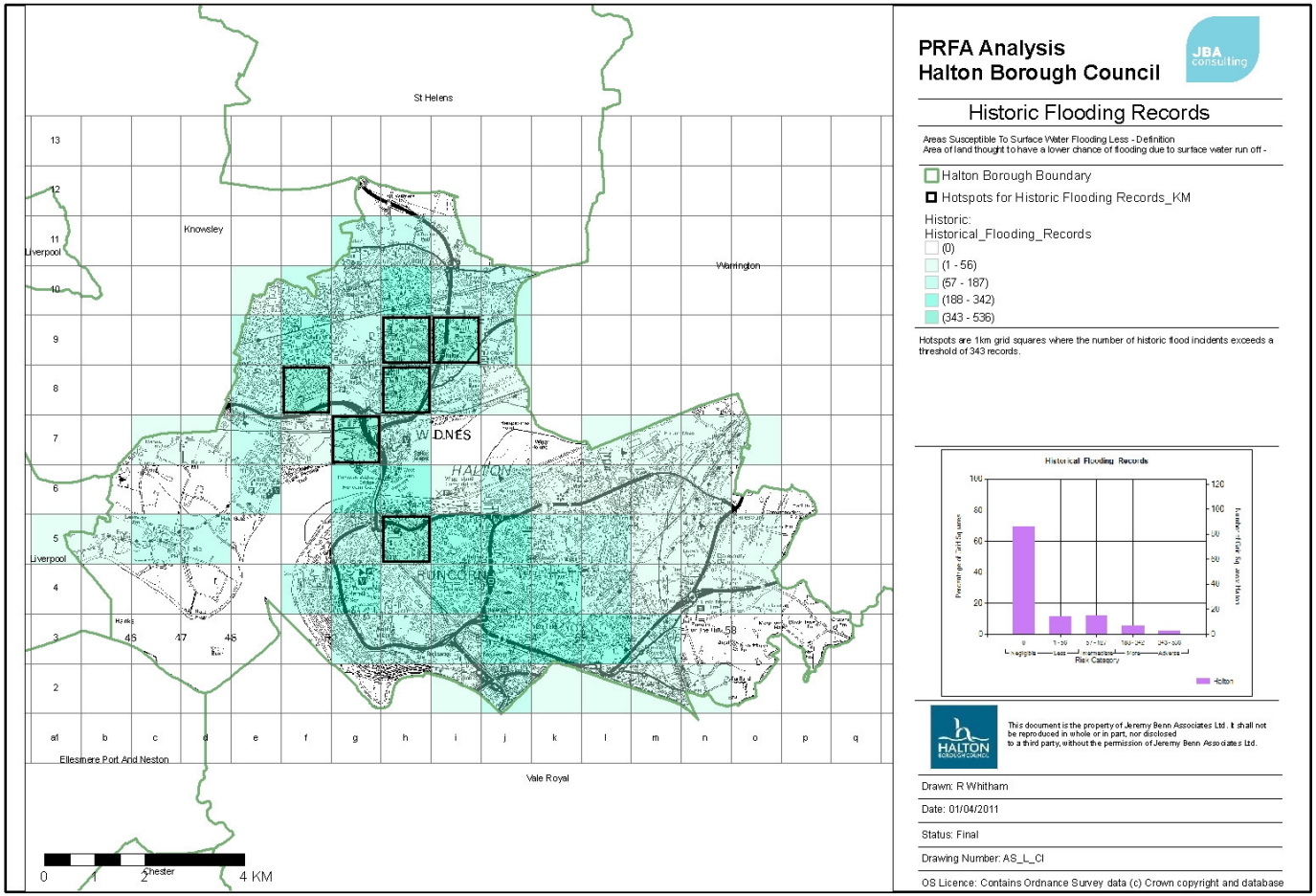
A selection of photographs has been included in Annex 7. These highlight the fact that there have been past floods in Halton, despite none being considered to have had significant harmful consequences based on the information that was available. Details of these flood events will be kept within the overall evidence base that Halton have built up and will go towards informing future work, as discussed above. The cause of flooding may not always be clear. In some instances flooding stems from sewer networks and at others from rivers or a combination both sources.

The consequence of the local historical incidents has also been assessed on a 1km grid square basis, similar to the Environment Agency future flood risk methodology. However, in this case no attempt has been made to set local significant thresholds. The consequences of

the local historical incidents are shown in Figure 4-2 illustrating those 1km square grids with the highest number of historical incidents. This figure highlights the following areas as having locally significant flood incidents:

- Peel House Lane
- Sandymoor (Keckwick)
- Cowan Way
- Mottershead Road

Figure 4-2 Historical Flooding Records within Halton



5. Assessing Future Flood Risk

5.1 Introduction

If a location does not have a recorded history of past floods, it does not necessarily mean that there is no risk. To ensure flood risk is assessed objectively, this PFRA also includes consideration of future flood risks. This assessment of future risk was primarily based on modelled information.

The following factors were considered when assessing future flood risk in Halton: topography; location of Ordinary Watercourses; location of floodplains that retain water; characteristics of watercourses; effectiveness of any works constructed for the purpose of flood risk management: the location of populated areas; areas comprising economic activity: the current and predicted impact of climate change; and the predicted impact of any long-term developments that may influence the occurrence or significance of flooding.

5.2 Future Floods and Consequences

The FRR requires consideration in the PFRA as to the potentially harmful consequences of floods on human health, economic activity and the environment (including cultural heritage).

The EA, with Defra, have identified flood risk indicators within each of these categories. Halton Council have analysed these indicators to identify flood risks and consequences within the borough.

This information is summarised in Annex 2 of this report as 'Preliminary_assessment_report_spreedsheet.xls'.

5.3 Overview of Future Flood Risk

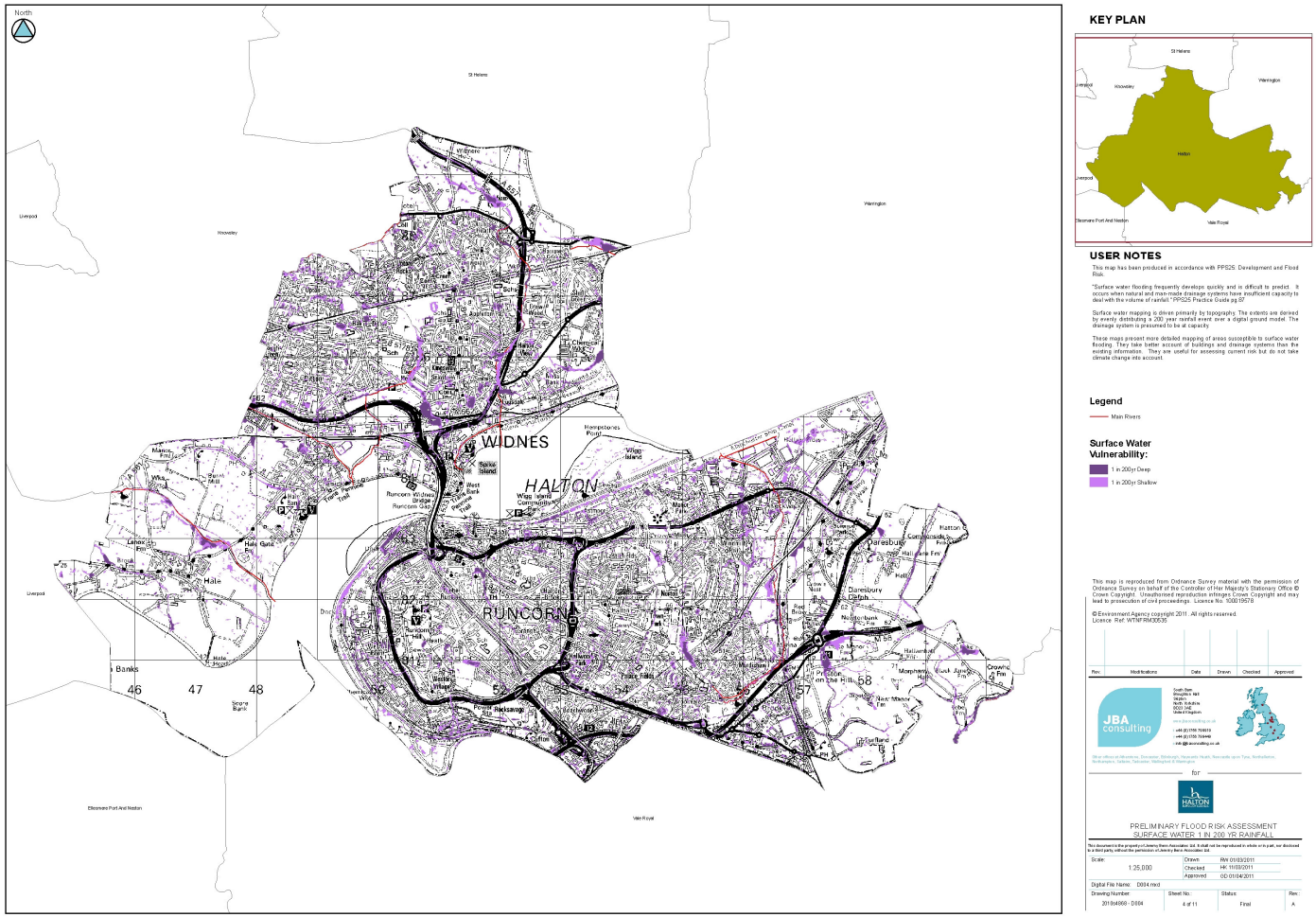
5.3.1 Surface Water Flooding

Halton Council have completed a Strategic Flood Risk Assessment, in which anticipated development and associated flood risks have been Sequentially Tested. It is intended that this approach to development and flood risk ensured that anticipated development does not increase flood risk and also that appropriate development only, in terms of flood risk, is permitted.

The Council is also in the process of preparing a Surface Water Management Plan. The results from this study will be used to inform the second cycle of the PFRA process and the production of flood hazard and flood risk maps for the area.

The Environment Agency (EA) has produced a national assessment of surface water flood risk in the form of two national mapping datasets. These comprise: the first generation national mapping (Areas Susceptible to Surface Water Flooding (AStSWF)) and the Flood Map for Surface Water (FMfSW), containing two flood events (1 in 30 annual chance and 1 in 200 annual chance) for two depth bandings (greater than 0.1m and greater than 0.3m). The Flood Map for Surface Water is included as Figure 5-1. This indicates those areas at risk of surface water flooding in the future.

Figure 5-1 Flood Map for Surface Water (FMfSW) for a 1 in 200 year rainfall event



The number of properties at risk of surface water flooding within Halton has been estimated using the EA's national datasets. From Table 5-1, the EA's second generation national mapping (FMfSW) predicts higher estimates of properties at risk.

Table 5-1 Properties at Risk from Future Surface Water Flooding

National Dataset	Banding	Number of Properties	Number of Residential Properties	Number of non-Residential Properties
Areas Susceptible to Surface Water Flooding	Less	9408	6733	2675
	Intermediate	4065	2838	1227
	More	715	432	319
Flood Map for Surface Water (1 in 200-yr)	>0.1m	12690	9747	2943
	>0.3m	3061	2293	768

Locally agreed surface water information

EA guidance on using surface water flood risk information recommends that Halton Council, as a LLFA, should: review; discuss; agree; and record the surface water flood data that best represents their local conditions. This should be completed in consultation with the EA, United Utilities and other stakeholders determine what surface water flood data best represents the local conditions. This will then be known as the locally agreed surface water information. Whilst this is not a requirement under the FRR, it does inform the PFRA process as this information should contribute to the identification of Flood Risk Areas.

There are three sources of surface water information across Halton; two national EA maps and one local suite of maps produced for Halton Council during the preparation of their PFRA. The SWMP is at the intermediate stage and five key areas have been identified for further detailed assessment. In total the SWMP has identified 6 sites in Widnes and 9 in Runcorn to undergo detailed Flood Risk Assessment.

The difference in modelling approach is summarised in Table 5-2.

Table 5-2 Summary of Surface Water Modelling Approaches

Variable	Areas Susceptible to Surface Water Flood (AStSWF)	PFRA Surface Water Mapping	Flood Map for Surface Water (FMfSW)	Halton Borough Council SWMP Mapping
Date	2008	2011	2010	2011
Coverage	National	Halton	National	Halton
Modelling Package	Jflow (diffusion wave)	Jflow + (shallow water equation)	Jflow (diffusion wave)	TUFLOW
Annual Probability Rainfall	1 in 200	1 in 75 1 in 200 1 in 1000	1 in 30 1 in 200	1 in 30 1 in 100 1 in 200
Storm Duration	6.5 hrs	1.1 to 10.1 hrs	1.1 hrs	1.1hrs
Rainfall Profile	50% Summer	50% Summer	50% Summer	50% Summer
Reduction to rainfall amount to represent infiltration	0 - No infiltration	Variable with soils	Reduced by 61% (to 39%) for rural areas and by 30% (to 70%) for urban areas.	Reduced by 61% (to 39%) for rural areas and by 30% (to 70%) for urban areas.
Reduction to rainfall amount to represent sewer flow	0 - Drainage systems assumed to be at capacity	Five year sewer capacity	0mm/hr rural 12mm/hr urban	Reduced by: 0mm/hr (Rural) 12mm/hr (Urban)
Sewer Spill Volumes	Not Considered	Not Considered	Not Considered	1 in 30 year sewer overflows included
Manning's' n'	0.1	0.03 urban 0.05 suburban 0.1 rural	0.1 rural 0.03 urban	0.03 Urban 1.0 Buildings 0.1 Greenfield
DTM	Infoterra bare earth LIDAR and Geo-Perspectives	EA LiDAR infilled with NextMap DTM	EA 2010 Composite	EA 2010 Composite
Model Resolution	5m	5m	5m	2m
Buildings	Not represented	With and without buildings scenarios	DTM raised by 5m	Manning's n increased to 1.0
Roads	Not considered	Not considered	Not considered	Not explicitly considered: Road drainage capacity included in sewer overflows
Threshold Bands	Less: 0.1 to 0.3m Intermediate: 0.3 to 1m More: >1m	0.1 to 0.3m, 0.3 to 1m, 1+m	Shallow: >0.1m Deep: >0.3m	Negligible <0.1m Shallow 0.1-0.3m Deep >0.3m

As part of the Halton Borough Council PFRA, JBA Consulting were commissioned to undertake enhanced surface water flood modelling and mapping of the Halton area. This mapping forms part of the JBA Comprehensive Flood Map. The data comprises of five flood perils; Fluvial (defended and undefended), Coastal (defended), Surface Water, Groundwater and Dam Break.

Information is available for mainland UK and a number of annual exceedance probabilities have been derived for each flood peril using the latest in-house software JFLOW-GPU and JFLOW+. The JFLOW modelling software range are 2D hydraulic models that are designed for broad scale modelling.

The EA derived Flood Map for Surface Water (FMfSW) dataset should be the "locally agreed surface water information" in Halton as it provides an overview of the future flood risk from surface water.

It has also been produced using the methodology developed by the EA that is available for use by all LLFAs. The FMfSW will also be used in the strategic/intermediate phase of the Council's SWMP. As a precautionary approach it also provides the highest property count as shown in Table 5-1.

Please note that there is a Surface Water Management Plans currently being prepared for Halton. The results to this appraisal will provide more accurate information on future flood risk in these areas and will form part of the 'locally agreed surface water information' once completed.

Surface Water Flood Risk in Halton compared to other North West LLFAs

Table 5-3 includes a comparison of the estimated number of properties at risk of surface water flooding across Halton and other Councils in the North West. This information was provided in 'Item 3 Supporting Information for all clusters England' of the Environment Agency PFRA guidance documentation.

Table 5-3 Number of properties at risk from surface water flooding in North West LLFAs

Council	Estimated number of properties susceptible to surface water flooding (flooding to a depth of 0.3m - with a 1 in 200 annual chance of occurring)
Halton	3,000
Knowsley	3,000
St Helens	4,700
Warrington	3,500
Cheshire West and Chester	6,900
Liverpool	10,000

This table indicates that Halton, along with Knowsley, have the lowest number of properties at risk from surface water flooding. This indicates the relatively low susceptibility to surface water flooding in Halton.

5.3.2 Groundwater Flooding

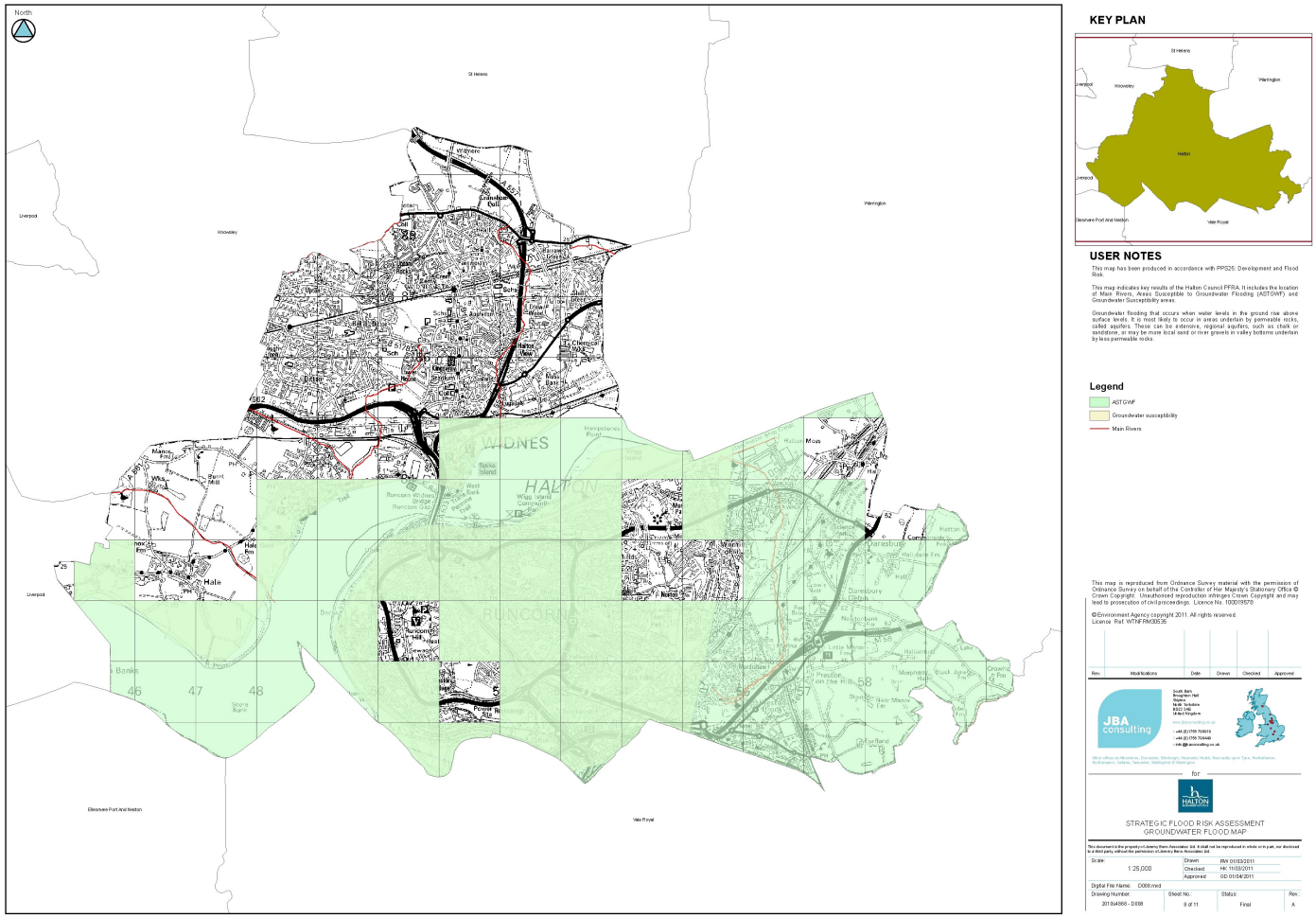
No quantifiable information is available that provides evidence of groundwater flood risk across Halton. The Environment Agency's national dataset (Areas Susceptible to Groundwater Flooding (ASTGWF)) has been used to form the basis for assessing future flood risk from groundwater.

The map has been derived using the top two susceptibility bands of the British Geological Society (BGS) 1:50,000 Groundwater Flood Susceptibility Map and, therefore, covers consolidated aquifers (chalk, sandstone etc., termed 'clear water' in the data attributes) and superficial deposits The mapping does not take flooding from groundwater rebound into

account but does indicate the proportion of each 1km grid square where geological and hydrogeological conditions may allow that groundwater to emerge.

As indicated in Figure 5-2, susceptible areas are represented by one of four area categories showing the proportion of each 1km square that is vulnerable to emerging groundwater.

Figure 5-2 Areas Susceptible to Groundwater Flooding



5.3.3 Manchester Ship Canal

Any impact of the Manchester Ship Canal has not been taken into account in this PFRA. The EA have received a judicial review for their flood mapping of the Manchester Ship Canal. The EA's website currently includes the following text.

"Users of the Flood Zone Map should be aware that we have received a judicial review challenge to the mapping of the Manchester Ship Canal at Trafford, Salford and Warrington on the ground that the preparation of the map is flawed in respect of our consideration of the role of the sluice gates in preventing flooding.

We are defending the challenge and believe and are advised that it is ill-founded. Nevertheless, pending determination of the challenge, users of the map need to consider whether the existence of the challenge, and the basis of it, affects the weight they judge may be given to the zoning of the Manchester Ship Canal within the Flood Map."

5.3.4 Ordinary watercourse flooding

The fluvial flood map has been used to assess the risk of flooding from Ordinary Watercourses. The Detailed River Network was used to identify Ordinary Watercourses and this was cross referenced with the Flood Map for Rivers and the Sea to assess future flood risks.

The flood zones associated with these Ordinary Watercourses have a very low quality rating as they are based primarily on early strategic flood zone modelling carried out by the EA. Whilst the EA Flood Map may not provide the best representation of future risk along these Ordinary Watercourses, the locally agreed surface water information could be used to illustrate flow patterns not readily identified by the Flood Map.

This dataset is illustrated in Annex **Error! Reference source not found.**. The number of properties within Flood Zone 3 has also been calculated, the results indicate a low consequence of flooding from this source.

5.3.5 Sewer flooding

No local or national information on future flood risk from sewers has been made available for this PFRA. The Halton SWMP may carryout detailed sewer modelling during the detailed risk assessment phase of the plan; however, this is likely to focus on specific locations in Halton. The results from the SWMP may be used to inform Halton Council's local flood risk management strategy.

5.4 Potential Consequences of Future Flooding

In order to ensure a consistent national approach, Defra have identified significance criteria and thresholds to be used for defining flood risk areas, see Table 3-1. Guidance on applying these thresholds has been released in Defra's document "Selecting and reviewing Flood Risk Areas for local sources of flooding". This guidance sets out key risk indicators and threshold values which must be used to determine Flood Risk Areas.

The EA has used the Flood Map for Surface Water mapping (FMfSW 1 in 200-year rainfall - deep) and the National Receptors Database to identify a number of areas across the country that exceed a given threshold, see Table 5-4.

Table 5-4 Flood significance threshold used to identify future consequences of flooding

'Significant harmful consequences' defined as greater than…	Description
200 people or	Flooded to a depth of 0.3m during a rainfall event with a 1 in 200 chance of occurring (or 0.5%)
20 businesses or	

1 critical service	

This assessment was based on 1km² national grid squares, and the grid squares that exceed this significance criterion were identified.

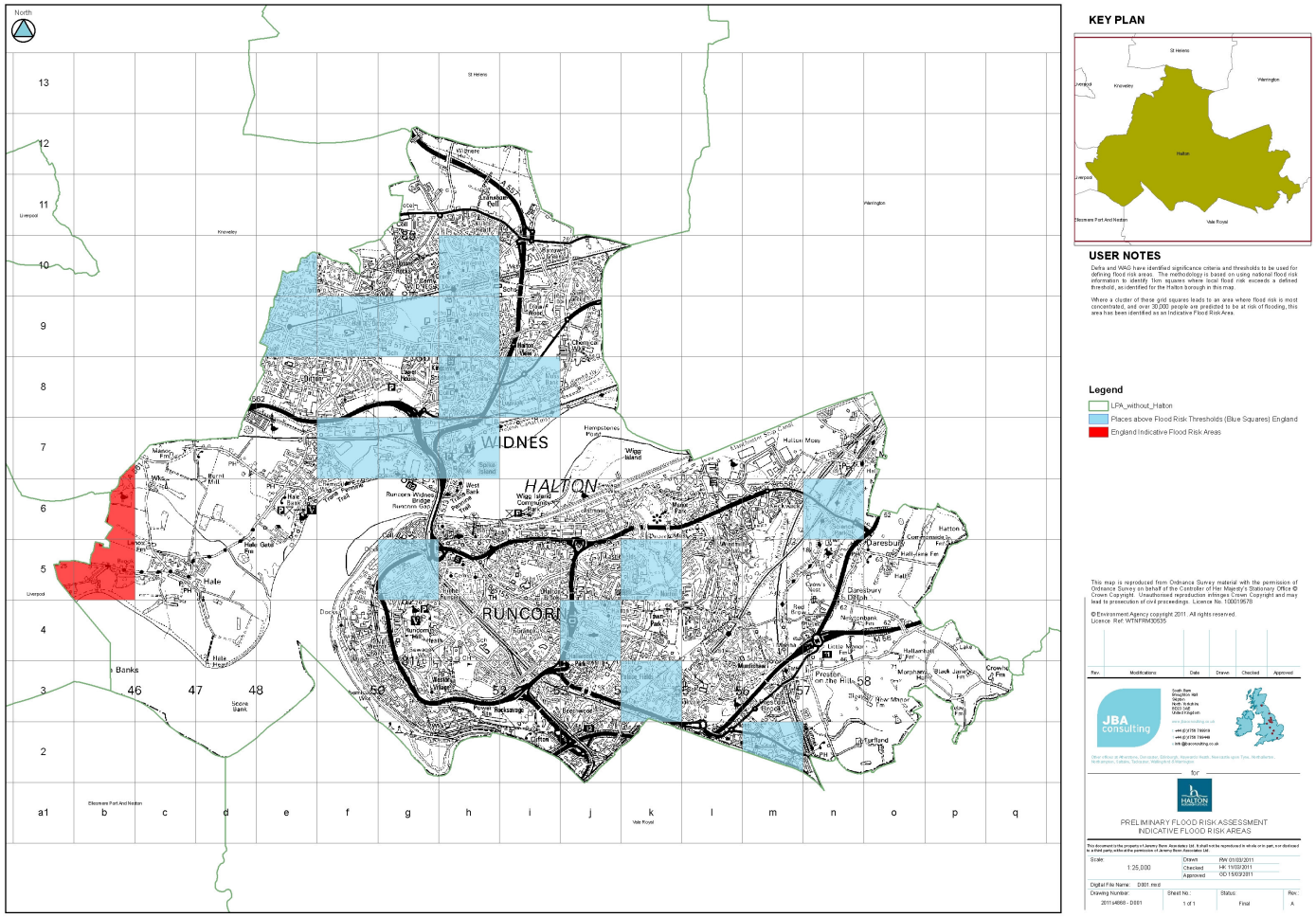
Within Halton there are 124, 1km² grid squares. Of these, the EA data identifies 17 as exceeding the thresholds listed in Table 5-4. These areas, as indicated on Figure 5-3, identify those areas likely to be at highest risk within the borough. Table 5-5 provides a more detailed summary of each of these areas.

Table 5-5 Flood risk threshold used to identify future consequences of flooding (Based on NRD)

Map Location ID	GRIDSQ	Number of People (average per household)	Number of Non-Residential Properties	Number of Critical Services
M2	X356Y379	2.34	22	0
K3	X354Y380	432.90	5	1
J4	X353Y381	74.88	55	2
G5	X350Y382	42.12	23	1
K5	X354Y382	634.14	5	0
N6	X357Y383	0.00	55	1
F7	X349Y384	0.00	5	2
G7	X350Y384	0.00	28	3
H7	X351Y384	21.06	26	1
H8	X351Y385	353.34	61	3
I8	X352Y385	0.00	26	0
E9	X348Y386	198.90	4	2
F9	X349Y386	201.24	3	1
G9	X350Y386	16.38	5	2
H9	X351Y386	194.22	42	0
E10	X348Y387	161.46	1	2
H10	X351Y387	245.70	7	0

Note: "Map Location ID" refers to the numbered grid squares as given on Figure 5-3.

Figure 5-3 Indicative Flood Risk Area within Halton



5.5 The Impacts of Climate Change and Long Term Developments

5.5.1 Introduction

The impact of climate change on local flood risk is relatively poorly understood. Several national flood maps have been used to inform this PFRA. These comprise: the Flood Map for Surface Water (surface runoff); Areas Susceptible to Surface Water Flooding (surface runoff); Areas Susceptible to Groundwater Flooding (groundwater); and Flood Map (Ordinary Watercourses). These do not show the impact of climate change on local flood risk.

There was consensus amongst climate model projections presented in the IPCC fourth assessment report for northern Europe suggesting that in winter high extremes of precipitation are very likely to increase in magnitude and frequency. These models project drier summers with increased chance of intense precipitation (intense heavy downpours interspersed with longer, relatively dry periods (Solomon et al., 2007).

5.5.2 The Evidence

There is clear scientific evidence that global climate change is happening now. It cannot be ignored.

Over the past century we have seen sea levels rise around the UK and more of our winter rain falling in intense wet spells. Seasonal rainfall is highly variable and it seems to have resulted in decrease in summer rainfall and an increase in winter rainfall (although the cumulative volume of winter rainfall has changed little in the last 50 years). Whilst the changes might reflect natural variation, however, the broad trends are in line with projections from climate models.

Greenhouse gas (GHG) levels in the atmosphere are likely to increase winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could ultimately effect climate change further into the future, but changes are still projected at least as far ahead as the 2080s.

We have enough confidence in large scale climate models to confirm that we must plan for change. There is more uncertainty at a local scale but model results can still help us plan and adapt. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance, or rarer) could increase locally by 40%.

5.5.3 Key Projections for North West River Basin District

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are

- Winter precipitation increases of around 14% (very likely to be between 4 and 28%)
- Precipitation on the wettest day in winter up by around 11% (very unlikely to be more than 25%)
- Relative sea level at Morecambe very likely to be up between 6 and 36cm from 1990 levels (not including extra potential rises from polar ice sheet loss)
- Peak river flows in a typical catchment likely to increase between 11 and 18%

Increases in rain are projected to be greater near the coast than inland.

5.5.4 Implications for Flood Risk

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

Wetter winters and more of this rain falling in wet spells may increase river flooding especially in steep, rapidly responding catchments. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

Drainage systems in the district have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

5.5.5 Adapting to Change

Past emission means some climate change is inevitable. It is essential we respond by planning ahead. We can prepare by understanding our current and future vulnerability to flooding, developing plans for increased resilience and building the capacity to adapt. Regular review and adherence to these plans is key to achieving long-term, sustainable benefits.

Although the broad climate change picture is clear, we have to make local decisions uncertainty. We will therefore consider a range of measures and retain flexibility to adapt. This approach, embodied within flood risk appraisal guidance, will help to ensure that we do not increase our vulnerability to flooding.

5.5.6 UKCP09

United Kingdom Climate Projections 2009 (UKCP09) provides the most up-to-date projections of future climate for the UK (http://ukclimateprojections.defra.gov.uk/). In terms of precipitation, the key findings are:

- By the 2080s, under Medium emissions, over most of lowland UK
- Central estimates are for heavy rain days (rainfall greater than 25 mm) to increase by a factor of between 2mm and 3.5mm in winter, and 1mm to 2mm in summer.
- By the 2080s, under Medium emissions, across regions in England & Wales the central estimate (50% probability) for winter mean precipitation change ranges from +14% to +23%. Central estimate for summer mean precipitation change ranges from -18% to -24%.
- Certain key processes such as localised convective rainfall are not represented within this modelling so there is still considerable uncertainty about rarer extreme rainfall events for the UK. We can be more certain that heavy rainfall will intensify in winter compared to summer. The proportion of summertime rainfall falling as heavy downpours may increase. The impact of these changes on local flood risk is not yet known.

5.5.7 Appraisal guidance

Current project appraisal guidance (Defra, 2006) provides indicative sensitivity ranges for peak rainfall intensity, for use on small catchments and urban/local drainage sites. These are due to be updated following the UKCP09 projections above.

They describe the following changes in peak rainfall intensity; +5% (1990-2025), +10% (2025-2055), +20% (2055-2085) and +30% (2085-2115).

This was reviewed by the Met Office in 2008 using UKCP09 models (Brown et al., 2008). They suggest that, on the basis of our current understanding, these levels represent a pragmatic but not a precautionary response to uncertainty in future climate impacts. In particular for a 1 in 5 year event, increases in precipitation intensity of 40% or more by the 2080s are plausible across the UK at the local scale.

5.5.8 Long-term developments

It is possible that long-term developments may influence both the occurrence and significance of flooding. However, current planning policy aims to prevent new development from increasing flood risk.

In England, Planning Policy Statement 25 (PPS25) on development and flood risk aims to "ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."

Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria).

5.6 Significant Local Developments

The Council has made clear in the SFRA that any new development should not increase flood risk. Significant new areas of development opportunity identified by the Council include:

- Mersey Gateway
- 3MG
- Widnes Waterfront
- East Runcorn (Sandymoor / Daresbury)

Surface water from planned development will need to be fully attenuated and mitigated on site. In accordance with PPS25 only appropriate development, in terms of flood risk and vulnerability, is envisaged.

6. Identification of Flood Risk Areas

6.1 Introduction

Defra has provided guidance on how nationally "significant" Flood Risk Areas have been determined. Ten of these Flood Risk Areas have been defined, with one area encroaching slightly into Halton. These national Flood Risk Areas are based on:

- adjoining (or clustered) locations where the pre-determined thresholds for property numbers and critical infrastructure are exceeded; and
- where the defined population thresholds within these areas are exceeded

Flood Risk Areas become the focus of Flood Hazard and Risk Mapping by 2013 and Flood Risk Management Plans by 2015, as required by the Flood Risk Regulations.

The guidance, therefore, focuses on nationally significant flood risk. However there are extensive areas that remain at risk of flooding and these must also be addressed. The PFRA provides the opportunity for LLFAs to include all of these locally important areas and consider how these are to be managed in the forthcoming local flood management strategies.

LLFAs are encouraged to consider the full range of local flood risk across their area, in addition to any areas of nationally significant risk. In view of the flooding issues across the borough, a further set of thresholds for residential properties, hence people, at risk of surface water flooding has been established. This provides additional categories of "low", "medium" and "high" consequence below "significant"(note renamed Adverse in Table 6-1, see section 6.2 for further details). In this way, the scale of consequence can be assessed and prioritised across the area.

Table 6-1 Categories of Flood Risk for Local Authorities

CATEGORY	NUMBER OF PEOPLE	NUMBER OF PROPERTIES
LOW CONSEQUENCE	>1 – 20 people	1 - 9 properties
MEDIUM CONSEQUENCE	21-99 people	10 - 42 properties
HIGH CONSEQUENCE	100-199 people	43 - 85 properties
ADVERSE CONSEQUENCE	>200 people	>85 properties

Using these locally applied thresholds, it is possible to analyse and produce an extensive suite of maps, to illustrate a range of flood sources affecting different indicators. Furthermore, these can be presented at any scale and on a Parish, Ward or County-wide basis. This will be of value in taking the management of flood risk forward in preparing the local strategy.

6.2 Differentiation between Local and National Flood Risk Areas

It should be noted that both the national guidance, set out by Defra for national flood risk analysis and the local flood risk areas defined in this PFRA report, both use the term ‘significance’. This, however, must be considered in context.

To elaborate, the terms ‘significance, adverse and critical infrastructure' should be brought back down to a local level rather than a national one. These terms will need to be defined in a local context in the Council’s Local Strategy documentation. What is deemed a ‘significant’ flood risk at national level should not necessarily be compared to locally ‘significant’ flood risk.

The Environment Agency have recently (March 2011) changed the term 'significant' to 'adverse' for all the consequence columns within Annex 2 of the PFRA. After consultation

with Halton Council we have agreed to use the following terminology in the study mapping, rather than a default of 'significant risk':

- Negligible
- Less Consequence
- Intermediate Consequence
- More Consequence
- Adverse Consequence (As now defined by EA Annex 2)

6.3 Review of the Widnes Cluster

As outlined in Section 5.4, the EA initially identified 17 individual 1km grid squares as being at significant risk. Following further analysis by the EA, one cluster of grid squares in Halton has been identified as illustrated in Figure 6-1. This cluster named by the EA as 'Widnes' is ranked 189 by number of people at risk in England and has an area of 1600 hectares.

This map is based on the EA's second generation surface water mapping (FMfSW). It does not meet the 30,000 people threshold required to be an Indicative Flood Risk Area and does not include the area within the defined Liverpool Flood Risk Area

It has 1568 people at risk (which equates to 670 houses, assuming 2.34 people per house national average occupancy). This flood risk cluster also affects 239 non-residential properties, of which 15 are critical infrastructure.

6.4 Review of the National Liverpool Indicative Flood Risk Area

It is understood that the EA's first generation mapping (AStSWF) rather than second generation surface water mapping (FMfSW) was used to define both the Hull and Liverpool Flood Risk Areas. For these areas the first generation mapping was considered to provide a more representative, if conservative estimate of flood risk.

The Liverpool Flood Risk Area, as illustrated in Figure 6-1, has 58127 people at risk (which equates to 24860 houses assuming 2.34 people per house national average occupancy). This flood risk cluster also impacts on 3948 non-residential properties, of which 301 are considered critical infrastructure.

Figure 6-2 shows the geographical extent of the national Indicative Flood Risk Area (with over 30,000 people) for Liverpool which is ranked 13 by number of people at risk in England. The proposed Flood Risk Area also covers large parts of the Liverpool, Knowsley and Sefton LLFA administrative areas. This area encroaches slightly into a predominantly rural area within Halton. It does not correspond with any future flood high risk areas (identified in the Halton Borough Council PFRA using local flood risk knowledge and data) which are summarised in the mapping of Annex **Error! Reference source not found.**.

Figure 6-1 Widnes Cluster Flood Risk Area

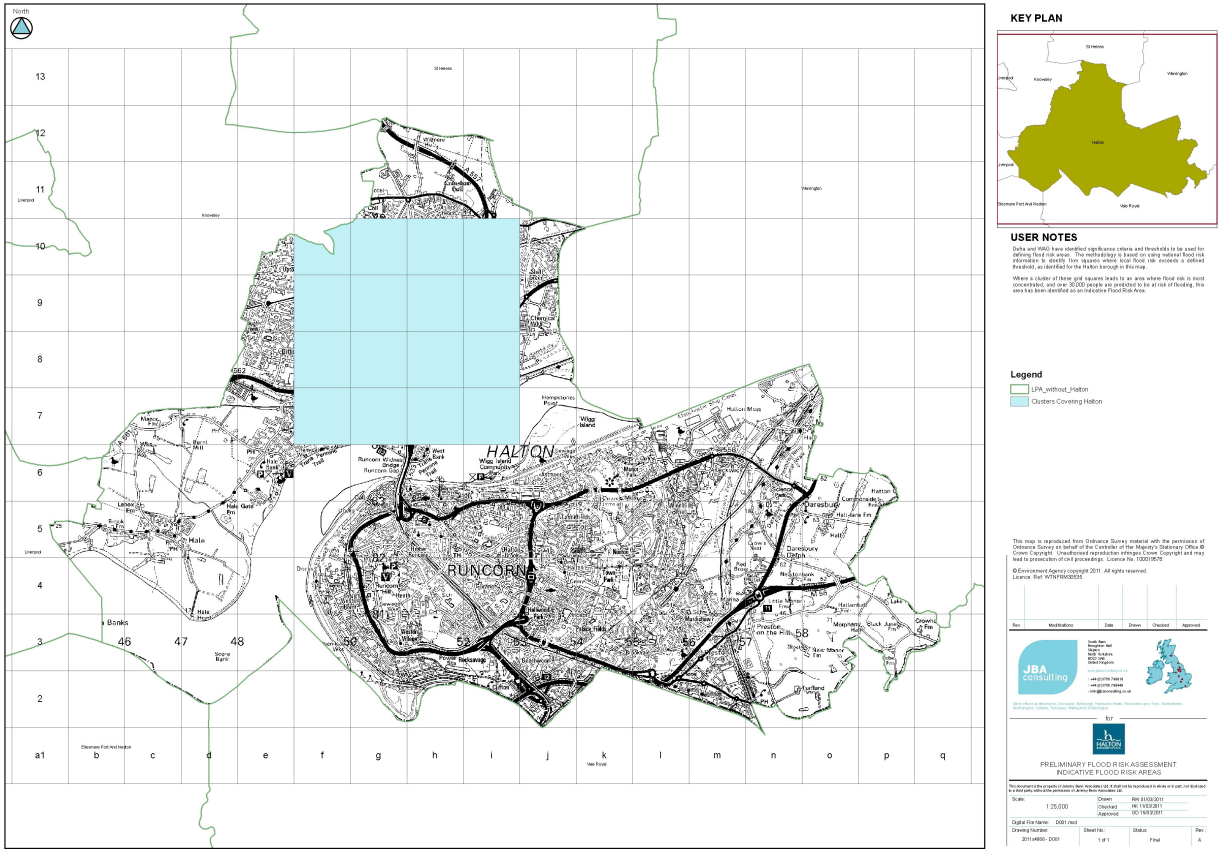
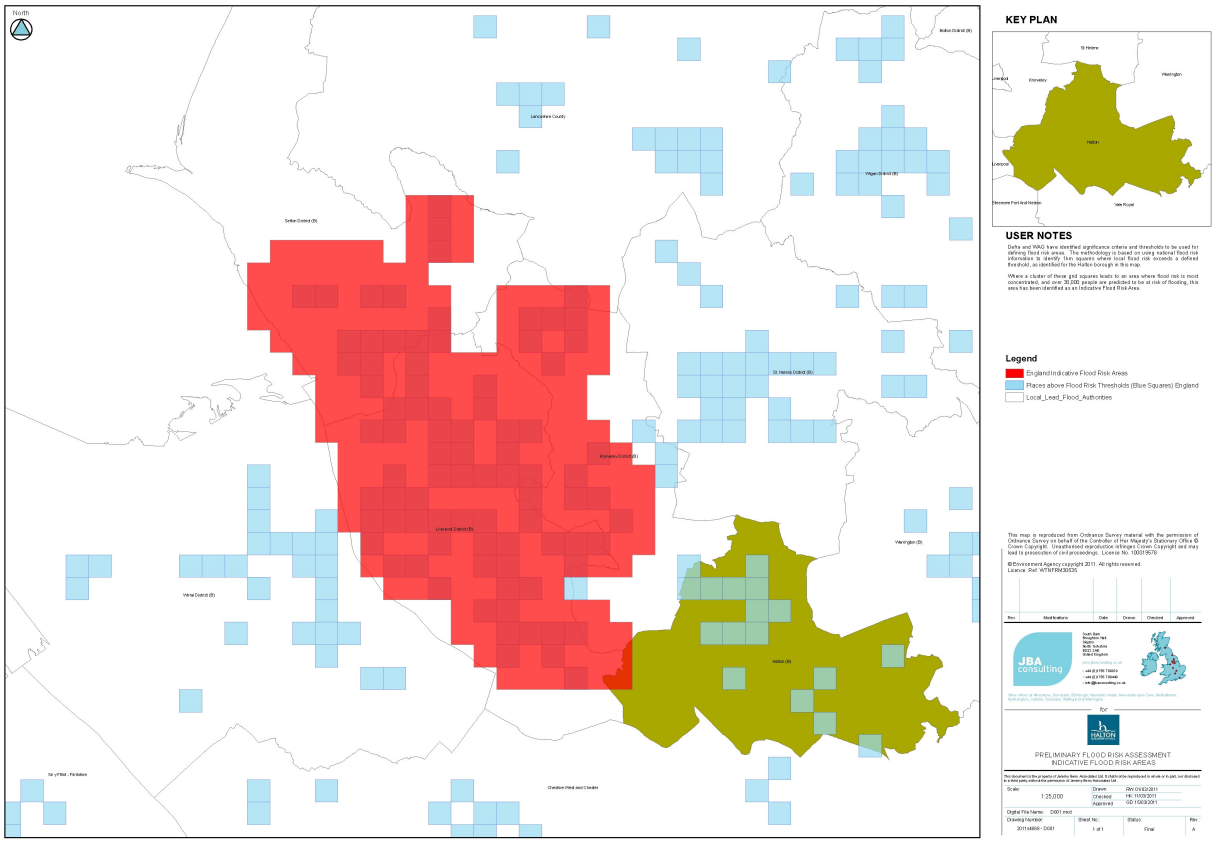


Figure 6-2 The Liverpool Indicative Flood Risk Area



6.5 Local Flood Risk Areas

It is important to remember that the national analysis of Indicative Flood Risk Areas are based on surface water flooding and on a subset of the significance criteria that can be measured at the national level.

It is, therefore, important that the Indicative Flood Risk Area in Halton is reviewed using the local information on past and future flood risk discussed in the previous sections of this report. In order to do so the following questions have been considered in Table 6-2.

Table 6-2 Indicative Flood Risk Area Review

Question	Response	Action
Is the FMfSW the most appropriate source of information?	Yes. Other local model outputs are available; however the FMfSW is the 'locally agreed surface water information". Halton Council agrees with this data being used to identify indicative Flood Risk Areas. The Liverpool Flood Risk Area is based on AStSWF data	No action
Are the consequences of flooding from other sources e.g. groundwater, Ordinary Watercourses likely to lead to significant Flood Risk Areas?	There are a number of areas which are at risk from multiple sources of flooding. However, the consequences of flooding in these locations are not large enough to exceed the Environment Agency thresholds. Local risks to be assessed within Halton local flood risk management strategy.	No action
Is there information on past floods which had significant harmful consequences?	It is assumed that whilst there have been historical flood incidents in Halton, none are considered to have had significant harmful consequences worthy of identifying a new Flood Risk Area in Halton.	No action
Is there any other information on the possible harmful consequences of future floods?	No	No action

The figures in Annex **Error! Reference source not found.** of Flood Risk Areas, defined by local knowledge and mapping, have been produced to aid this review. What can be taken from these maps, is that whilst the data collected does not identify new nationally significant areas, it does highlight those areas in Halton which are at risk from a number of source which are supported by local historical data.

6.6 Local Flood Risk Analysis

As part of the local flood risk analysis, consequence maps (included in Annex A8) have been produced to identify key areas of flooding in the borough.

List 1: Maps for each of the following scenarios are included:

- Flood Zone 2;
- Flood Zone 3;
- FMfSW 200yr deep;
- FMfSW 200yr shallow; and,

- ASTGWF (75% risk)

Each scenario (identified in List 1) has been analysed against the National Receptor Database (List 2) to produce a suite of five maps for each flooding scenario.

(It should be noted that other flood scenarios and National Receptor Database classes have also been analysed and the results are summarised in Annex 2.)

List 2: For the mapping included in Annex 8, the National Receptor Database comprises:

- Residential;
- Non-Residential;
- Critical Infrastructure;
- Roads; or,
- Rail.

6.6.1 Interpreting the Maps

As indicated on Figure 6-3, each map has a graduated colour scheme that indicates the flood consequence level for each grid cell as being either:

- Negligible;
- Less;
- Intermediate;
- More; or
- Adverse.

Any grid cell categorised as being of "adverse consequence" is further highlighted by the inclusion of a black border to the grid cell. These hotspot appears on each of the five maps for each of the flooding scenarios, irrespective of consequence level.

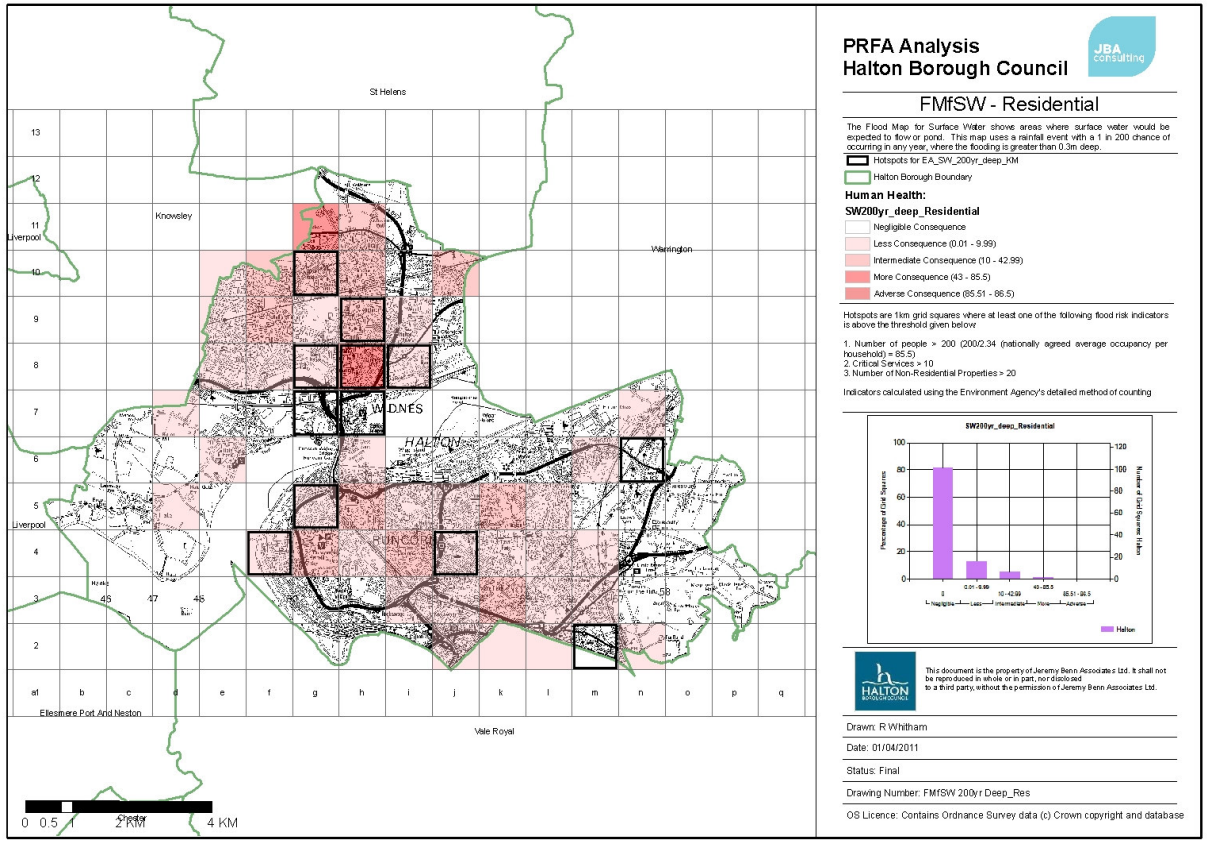
For instance: From Figure 6-3:

- From list 1 - FMfSW 200yr deep
- From list 2 - Residential

From inspection:

- Grid cell H8 is highlighted as being an area of "adverse consequence" by use of the dark red shading. This cell is further highlighted as a hotspot by the use of a black border.
- Grid cell M2 is highlighted as being an area of "negligible consequence" as the grid cell is white. However, it is also highlighted as a hotspot by the black border as one of the other categorise (Non-Residential, Critical Infrastructure, Roads or Rail) must define this cell as being of adverse consequence for the "FMfSW 200yr deep" scenario.

Figure 6-3 Local Flood Risk Hotspots



6.7 New Flood Risk Areas

It is proposed that minor changes to the Liverpool indicative Flood Risk Area in Halton to more accurately reflect local conditions. The Liverpool Flood Risk Area has been removed from the Halton area as it only slightly encroaches into a predominantly rural area, on the periphery, of the borough and does not coincide with the locally defined areas of consequence.

This revision reflects the relevant administrative boundaries, urban areas, the limited historical flood incident records in the area and the analysis of significant future flood risk resulting from this study.

Halton Borough Council will take on the responsibility of reporting this information within Annex 3 of their Preliminary Assessment Spreadsheet.

6.8 Conclusions

As a result of the key questions raised in Table 6-2 above, Halton Council disagrees with the Environment Agency's national Indicative Flood Risk Area in Halton. As a result, it will not be recorded in Annex 3 of the Preliminary Assessment Spreadsheet.

7. Next Steps

It is recommended that the Liverpool Flood Risk Area should be removed from the Halton area as it only slightly encroaches into a predominantly rural area, on the periphery, of the borough. In addition, the Liverpool Flood Risk Area does not coincide with the local mapping undertaken for this PFRA, as indicated in Annex 8. This removes the requirement to produce flood hazard and risk maps and to prepare a flood risk management plan for the area. However, the Council must demonstrate continued commitment to local flood risk management.

The PFRA cycle will start again in 2016, so it is important to ensure that information is maintained and kept up-to-date for future use and to support other flood risk assessments (such as SWMPs, SFRAs) and as part of any local flood risk strategy. In the next cycle, more information will be mandatory for floods that occur after 22 December 2011.

The Council, along with the sub-regional group, is currently developing a flood investigations process that will support the data gathering process.

The first review cycle of the PFRA will be led by Halton Council and must be submitted to the Environment Agency by the 22nd of June 2017. They will then submit it to the European Commission by the 22nd of December 2017 using the same review procedure described above.

7.1 Future Data Management Arrangements

In order to continue to fulfil their role as Local Lead Flood Authority, Halton Borough Council is required to investigate future flood events and ensure continued collection, assessment and storage of flood risk data and information.

It is likely that this requirement will be met most effectively by the Council recording events as they occur within their administrative areas. However, it is crucial that all records of flood events are documented consistently and in accordance with the INSPIRE Directive (2007/2/EC).

It is recommended that a centralised database is kept up-to-date by Halton Borough Council. This can be used as an evidence base to inform future assessments and reviews and for input into the mapping and planning stages.

The proposed method for flood event data collection and management is included in Figure 7-1 below. A simple spreadsheet system has been created in which the Council can record details of flooding in the borough. The fields are colour coded to represent the details which are compulsory and those which would be useful to have but not essential.

Figure 7-1 Flood Event Data Recording System

HALTON BOROUGH COUNCIL

Flood Event Data Recording System

Compulsory | Preferred | Optional

Records kept from:
Records kept to:

	Flood Event (Outline Name)	Event Date	Location (Address, Town)	Location (Postcode or Grid Reference)	Event Duration (hours)	Estimated Return Period of Event	Depth of Flooding (m)	Extent of Flooding (m^2)	Flooding Source	Confidence of Source	Residential Properties Flooded	Commercial Properties Flooded	Critical Infrastructure at risk
Example:	*November 2005 Hale Bank Road*	*18/01/2005.*	*Hale Bank Road*	*SJ47723842 79*	*2*	*1 in 5*	*0.5m*	*50*	*Pluvial*	*High*	*0*	*1*	*0*

							Rainfall Event	
	Damage Caused	Photos of Flood Event	Photo File Location	Details of any Actions Taken	Issue Resolved	Additional Notes or Information	Rainfall Depth (mm)	Rainfall Duration (hours)
	Post Office Flooded - minor damage	*Yes*	*C:\Flooding Photos\2005*	*none*	*No*		*20*	*4*

7.2 Scrutiny & Review Procedures

The scrutiny and review procedures that must be adopted when producing a PFRA are set out by the European Commission. Meeting quality standards is important in order to ensure that the appropriate sources of information have been used to understand flood risk and the most significant flood risk areas are identified.

Another important aspect of the review procedure is to ensure that the guidance is applied consistently. A consistent approach will allow all stakeholders to understand the risk and manage it appropriately. The scrutiny and review procedure will comprise two key steps, as indicated below.

7.2.1 Local Authority Review

The first part of the review procedure is through an internal Local Authority review of the PFRA, in accordance with appropriate internal review procedures. Internal approval should be obtained to ensure the PFRA meets the required quality standards, before it is submitted to the EA.

Within Halton, the PFRA will be taken to the environment and urban renew policy and performance board (scrutiny committee) for approval. It will then be taken for approval by the Halton Borough Council cabinet (executive board) before being delivered to the EA.

7.2.2 Environment Agency Review

Under the Flood Risk Regulations, the EA has been given a role in reviewing, collating and publishing all of the PFRAs once submitted. The EA will undertake a technical review (area review and national review) of the PFRA, which will focus on instances where Flood Risk Areas have been amended and ensure the format of these areas meets the provide standard. If satisfied, they will recommend submission to the relevant Regional Flood Defence Committee (RFDC) for endorsement. RFDCs will make effective use of their local expertise and ensure consistency at a regional scale. Once the RFDC has endorsed the PFRA, the relevant EA Regional Director will sign it off, before all PFRAs are collated, published and submitted to the European Commission.

The first review cycle of the PFRA will be led by Halton Borough Council and must be submitted to the Environment Agency by the 22nd of June 2017. They will then submit it to the European Commission by the 22nd of December 2017 using the same review procedure described above.

Appendices

A.1 Preliminary assessment report

Preliminary assessment spreadsheet. This annex also contains the HBC centralised database of locally significant historical flooding records in the borough.

A.2 Preliminary assessment spreadsheet:

- **Records of past floods and their significant consequences (preliminary assessment report spreadsheet)**

Please refer to Annex 1 of the Preliminary Assessment Spreadsheet attached with this report.

- **Records of future floods and their consequences (preliminary assessment report spreadsheet)**

Please refer to Annex 2 of the Preliminary Assessment Spreadsheet attached with this report. This spreadsheet includes a complete record of future flood risk within Halton, including details of the potential consequences of flooding to key risk receptors within the county.

- **Records of Flood Risk Areas and their rationale (preliminary assessment report spreadsheet)**

Please refer to Annex 3 of the Preliminary Assessment Spreadsheet attached with this report. This spreadsheet includes information and details about the identified Flood Risk Area within Halton. A GIS layer of flood risk area(s) has been submitted to Halton Council as a deliverable of the PFRA.

A.3 Review checklist

Please refer to Annex 4, attached to this report, which contains the Review Checklist that has been provided by the Environment Agency to act as a checklist for reviewing PFRA submissions.

A.4 Preliminary assessment maps

The Flood Risk Regulations 2009 place a duty on the Environment Agency to prepare Preliminary Assessment Maps (Reg. 9 & 11) for the river basin districts. These have been generated for the eleven river basin districts. Each map is required to show river basin district boundaries, the coastline boundary, land use and topography.

A.5 GIS Data

GIS deliverables of the study, which comply with the data standards for PFRA documents, are to be submitted to the EA.

A.6 Definitions of flood risk indicators

This annex provides an explanation of the indicators used to define the indicative Flood Risk Areas. The indicative Flood Risk Areas were identified using property types in the National Receptor Dataset (NRD) version 1.0. An updated version (1.1) of the NRD is now available.

A.7 Inventory of Key Flood Risk Photos

The following selection of photos was acquired from a number of sources; these photos are representative of the issues relating to all sources of flooding across Halton. In some

instances flooding stems from sewer networks and at others from rivers or a combination both sources.

7.3 Fluvial

7.3.1 Bowers Brook

Bowers Brook Bongs

7.3.2 Keckwick Brook

Blackheath Lane

Eastgate Road

Lidl Eastgate Road

Furness Court

Blackheath Lane

Eastgate Road

Wharford Farm

Lidl Eastgate Road

Lidl Eastgate Road

Furness Court

Newmoore Lane

Newmoore Lane

7.3.3 Ditton Brook

Ditton Road

7.3.4 Alder Brook

Cherry Sutton

7.4 Tidal Mersey

Hale Gate Road

Ditton Road

Hale Gate Road

Ditton Road

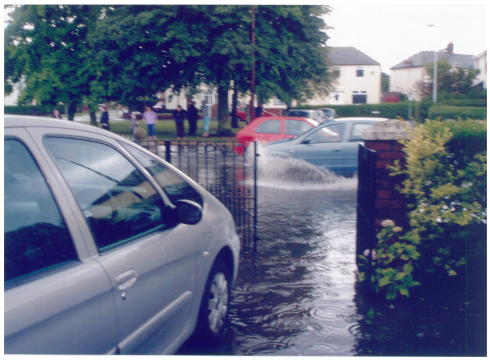
St Michael's Road

Hale Road

7.5 Sewer

The Glen

Kingsway



Peel House Lane

Milton Road

A.8 Locally Defined Flood Risk Area Mapping

JBA Para Text

PRFA Analysis
Halton Borough Council

JBA consulting

75% of AStGWF - Critical Infrastructure

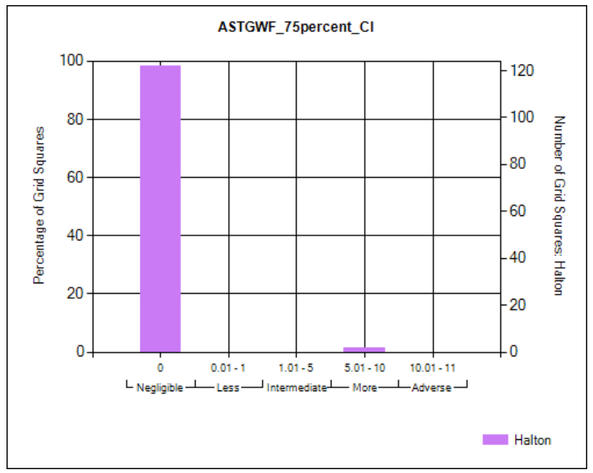
Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. It was developed specifically by the Agency for use by Lead Local Flood Authorities (LLFAs) for use in PFRAs.

- Halton Borough Boundary
- Hotspots for ASTGWF_75percent_KM

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



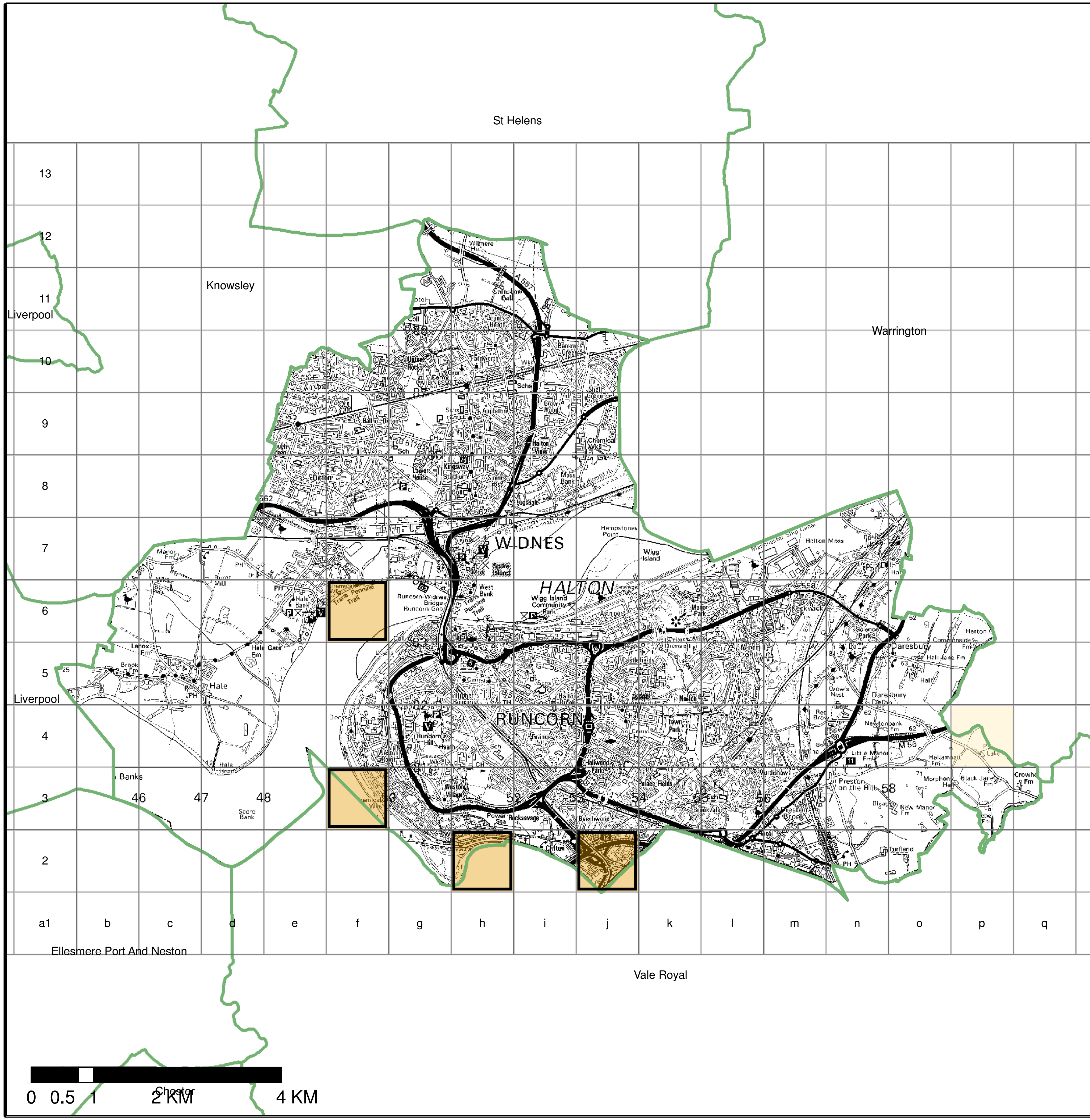
Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: AStGW_CI

0 0.5 1 2 KM 4 KM



PRFA Analysis
Halton Borough Council

75% of AStGWF - Non-Residential

Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. It was developed specifically by the Agency for use by Lead Local Flood Authorities (LLFAs) for use in PFRAs.

- Halton Borough Boundary
- Hotspots for ASTGWF_75percent_KM

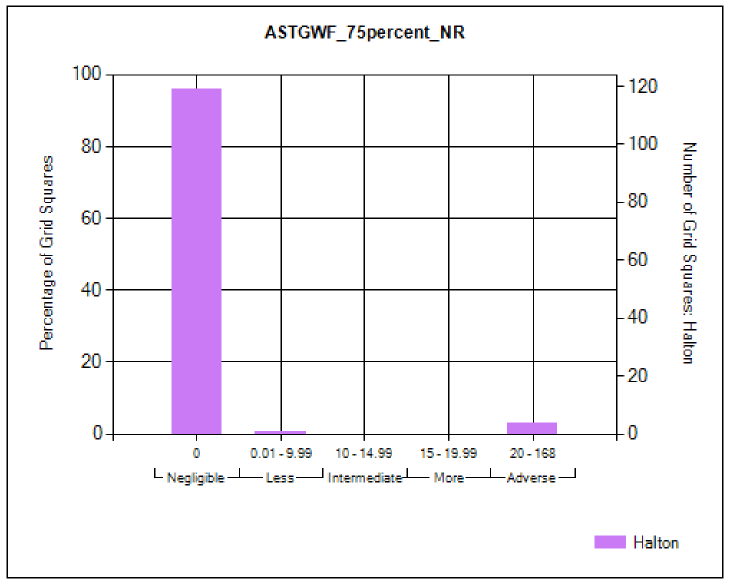
Economic:
ASTGWF_75percent_NR

- Negligible Consequence
- Less Consequence (0.01 - 9.99)
- Intermediate Consequence (10 - 14.99)
- More Consequence (15 - 19.99)
- Adverse Consequence (20 - 168)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: AStGW_NR

PRFA Analysis
Halton Borough Council

JBA consulting

75% of AStGWF - Rail

Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. It was developed specifically by the Agency for use by Lead Local Flood Authorities (LLFAs) for use in PFRAs.

- Halton Borough Boundary
- Hotspots for ASTGWF_75percent_KM

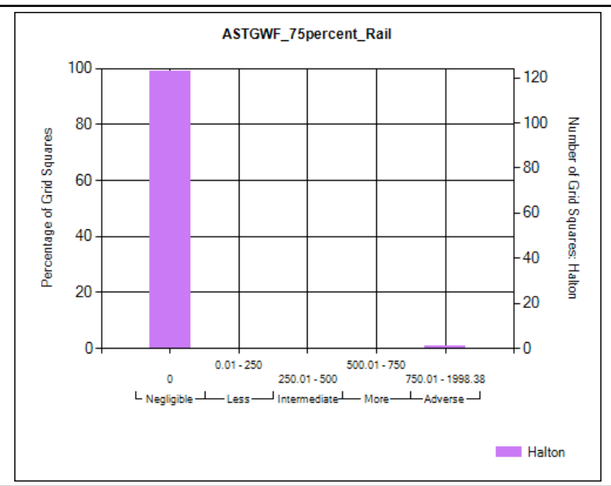
Economic:
ASTGWF_75percent_Rail

- Negligible Consequence
- Less Consequence
- Intermediate Consequence
- More Consequence
- Adverse Consequence (0.01 - 1998)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: AStGW_Rail

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

75% of AStGWF - Residential

Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. It was developed specifically by the Agency for use by Lead Local Flood Authorities (LLFAs) for use in PFRAs.

- Halton Borough Boundary
- Hotspots for ASTGWF_75percent_KM

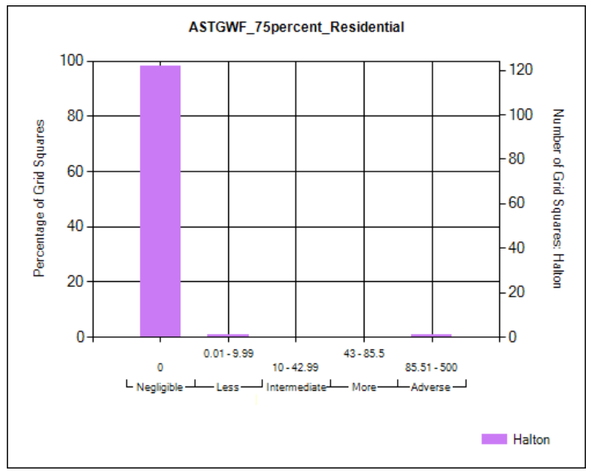
Human Health:
ASTGWF_75percent_Residential

- Negligible Consequence
- Less Consequence (0.01 - 9.99)
- Intermediate Consequence (10 - 42.99)
- More Consequence (43 - 85.5)
- Adverse Consequence (85.51 - 500)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: AStGW_Res

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

75% of AStGWF - Road

Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. It was developed specifically by the Agency for use by Lead Local Flood Authorities (LLFAs) for use in PFRAs.

- Halton Borough Boundary
- Hotspots for ASTGWF_75percent_KM

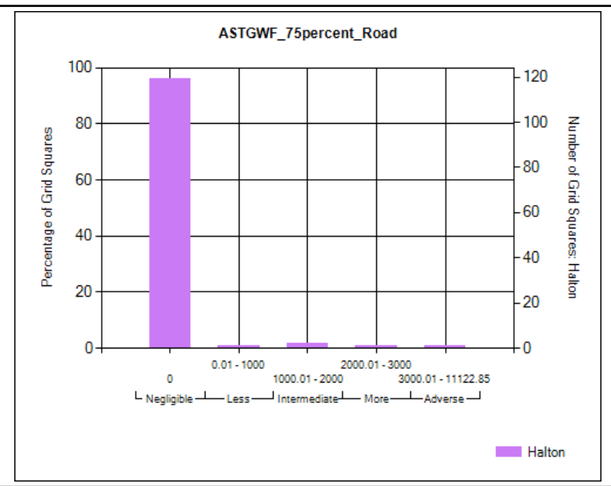
Economic:
ASTGWF_75percent_Road

- Negligible Consequence
- Less Consequence (0.01 - 1000)
- Intermediate Consequence (1000.01 - 2000)
- More Consequence (2000.01 - 3000)
- Adverse Consequence (3000.01 - 11122.85)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



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Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: AStGW_Road

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

FMfSW - Critical Infrastructure

The Flood Map for Surface Water shows areas where surface water would be expected to flow or pond. This map uses a rainfall event with a 1 in 200 chance of occurring in any year, where the flooding is greater than 0.3m deep.

- Hotspots for EA_SW_200yr_deep_KM
- Halton Borough Boundary

Human Health:

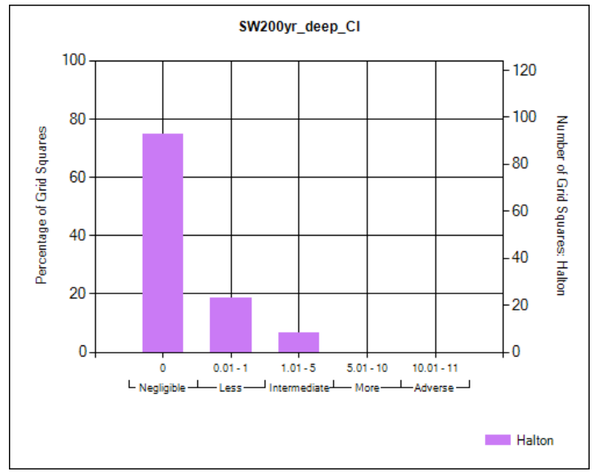
SW200yr_deep_CI

- Negligible Consequence
- Less Consequence (0.01 - 1)
- Intermediate Consequence (1.01 - 5)
- More Consequence (5.01 - 10)
- Adverse Consequence (10.01 - 11)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FMfSW 200yr Deep_CI

St Helens
Knowsley
Liverpool
Warrington
Ellesmere Port And Neston
Vale Royal
Chester
WIDNES
HALTON
RUNCORN
0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

FMfSW - Non-Residential

The Flood Map for Surface Water shows areas where surface water would be expected to flow or pond. This map uses a rainfall event with a 1 in 200 chance of occurring in any year, where the flooding is greater than 0.3m deep.

Hotspots for EA_SW_200yr_deep_KM

Economic:

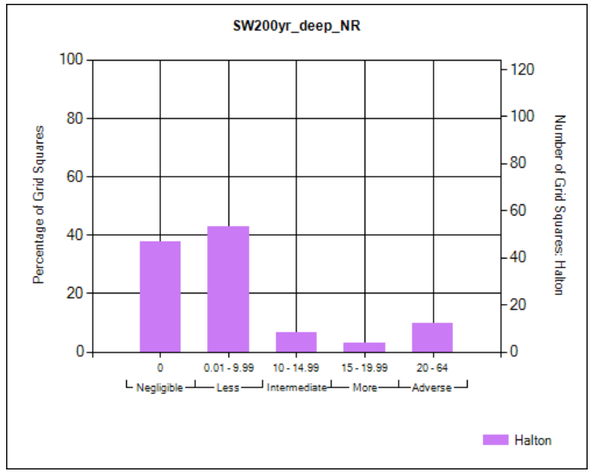
SW200yr_deep_NR

- Negligible Consequence
- Less Consequence (0.01 - 9.99)
- Intermediate Consequence (10 - 14.99)
- More Consequence (15 - 19.99)
- Adverse Consequence (20 - 64)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FMfSW 200yr Deep_NR

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

FMfSW - Rail

The Flood Map for Surface Water shows areas where surface water would be expected to flow or pond. This map uses a rainfall event with a 1 in 200 chance of occurring in any year, where the flooding is greater than 0.3m deep.

Hotspots for EA_SW_200yr_deep_KM

Halton Borough Boundary

Economic:

EA_SW_200yr_deep_Rail

Negligible Consequence

Less Consequence (0.01 - 250)

Intermediate Consequence (250.01 - 500)

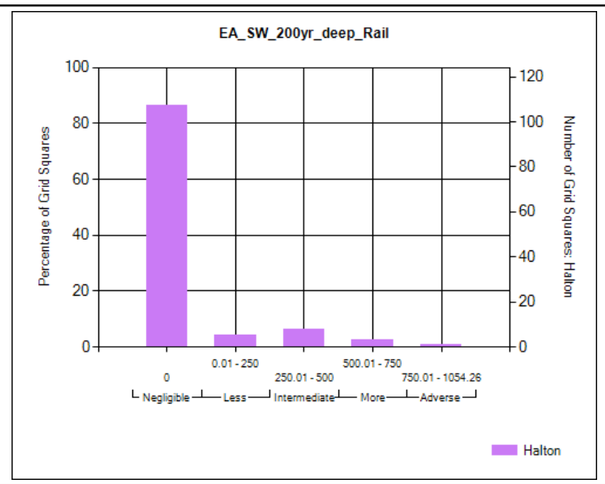
More Consequence (500.01 - 750)

Adverse Consequence (750.01 - 1054.26)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FMfSW 200yr Deep_Rail

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

FMfSW - Residential

The Flood Map for Surface Water shows areas where surface water would be expected to flow or pond. This map uses a rainfall event with a 1 in 200 chance of occurring in any year, where the flooding is greater than 0.3m deep.

Hotspots for EA_SW_200yr_deep_KM

Halton Borough Boundary

Human Health:

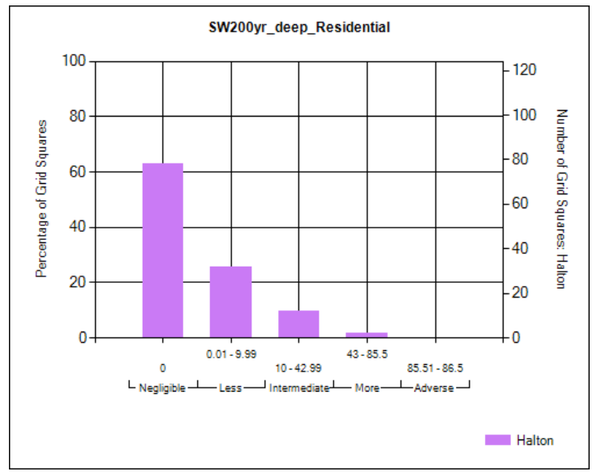
SW200yr_deep_Residential

- Negligible Consequence
- Less Consequence (0.01 - 9.99)
- Intermediate Consequence (10 - 42.99)
- More Consequence (43 - 85.5)
- Adverse Consequence (85.51 - 86.5)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



HALTON BOROUGH COUNCIL

Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FMfSW 200yr Deep_Res

OS Licence: Contains Ordnance Survey data (c) Crown copyright and database

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

FMfSW - Roads

The Flood Map for Surface Water shows areas where surface water would be expected to flow or pond. This map uses a rainfall event with a 1 in 200 chance of occurring in any year, where the flooding is greater than 0.3m deep.

Hotspots for EA_SW_200yr_deep_KM

Halton Borough Boundary

Economic:

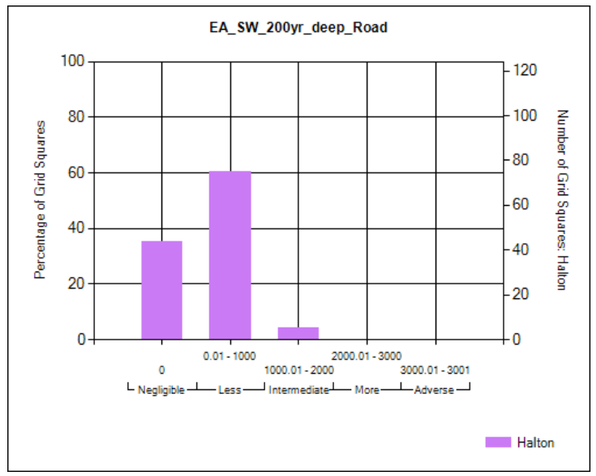
EA_SW_200yr_deep_Road

- Negligible Consequence
- Less Consequence (0.01 - 1000)
- Intermediate Consequence (1000.01 - 2000)
- More Consequence (2000.01 - 3000)
- Adverse Consequence (3000.01 - 3001)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FMfSW 200yr Deep_Road

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

FMfSW - Critical Infrastructure

The Flood Map for Surface Water shows areas where surface water would be expected to flow or pond. This map uses a rainfall event with a 1 in 200 chance of occurring in any year, where the flooding is greater than 0.1m deep.

Hotspots for EA_SW_200yr_shallow_KM

Halton Borough Boundary

Human Health:

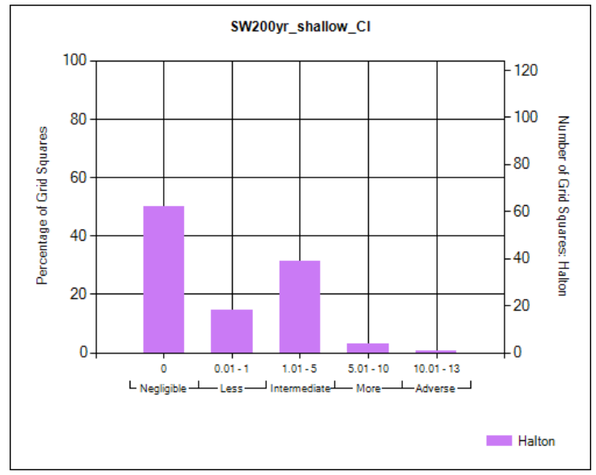
SW200yr_shallow_CI

- Negligible Consequence
- Less Consequence (0.01 - 1)
- Intermediate Consequence (1.01 - 5)
- More Consequence (5.01 - 10)
- Adverse Consequence (10.01 - 13)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FMfSW 200yr Shallow_CI

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

FMfSW - Non-Residential

The Flood Map for Surface Water shows areas where surface water would be expected to flow or pond. This map uses a rainfall event with a 1 in 200 chance of occurring in any year, where the flooding is greater than 0.1m deep.

Hotspots for EA_SW_200yr_shallow_KM

Halton Borough Boundary

Economic:

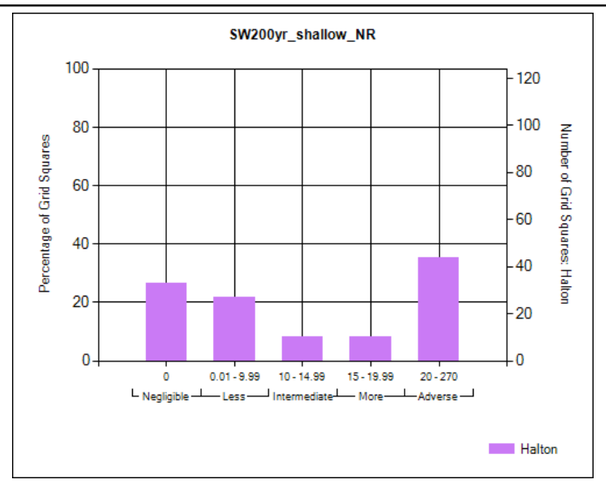
SW200yr_shallow_NR

- Negligible Consequence
- Less Consequence (0.01 - 9.99)
- Intermediate Consequence (10 - 14.99)
- More Consequence (15 - 19.99)
- Adverse Consequence (20 - 270)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FMfSW 200yr Shallow_NR

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

FMfSW - Rail

The Flood Map for Surface Water shows areas where surface water would be expected to flow or pond. This map uses a rainfall event with a 1 in 200 chance of occurring in any year, where the flooding is greater than 0.1m deep.

Hotspots for EA_SW_200yr_shallow_KM

Halton Borough Boundary

Economic:

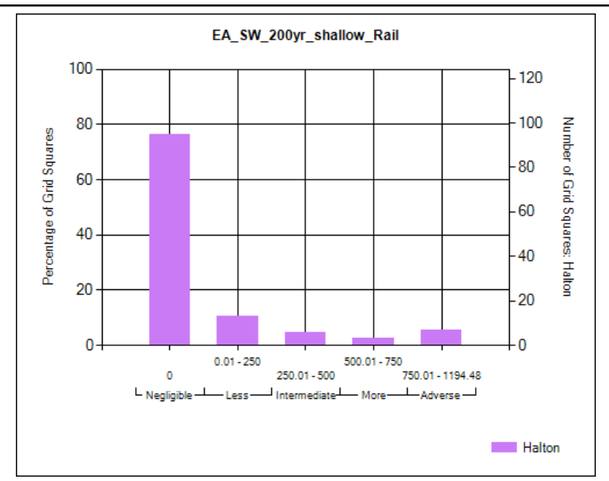
EA_SW_200yr_shallow_Rail

- Negligible Consequence
- Less Consequence (0.01 - 250)
- Intermediate Consequence (250.01 - 500)
- More Consequence (500.01 - 750)
- Adverse Consequence (750.01 - 1194.48)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FMfSW 200yr Shallow_Rail

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

FMfSW - Residential

The Flood Map for Surface Water shows areas where surface water would be expected to flow or pond. This map uses a rainfall event with a 1 in 200 chance of occurring in any year, where the flooding is greater than 0.1m deep.

Hotspots for EA_SW_200yr_shallow_KM

Halton Borough Boundary

Human Health:

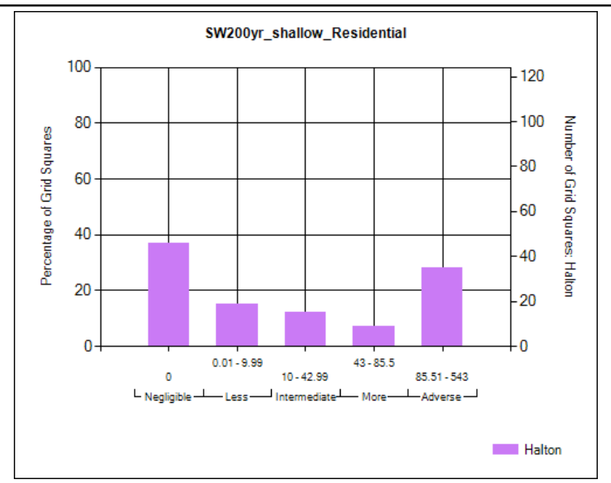
SW200yr_shallow_Residential

- Negligible Consequence
- Less Consequence (0.01 - 9.99)
- Intermediate Consequence (10 - 42.99)
- More Consequence (43 - 85.5)
- Adverse Consequence (85.51 - 543)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FMfSW 200yr Shallow_Res

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

FMfSW - Road

The Flood Map for Surface Water shows areas where surface water would be expected to flow or pond. This map uses a rainfall event with a 1 in 200 chance of occurring in any year, where the flooding is greater than 0.1m deep.

Hotspots for EA_SW_200yr_shallow_KM

Halton Borough Boundary

Economic:

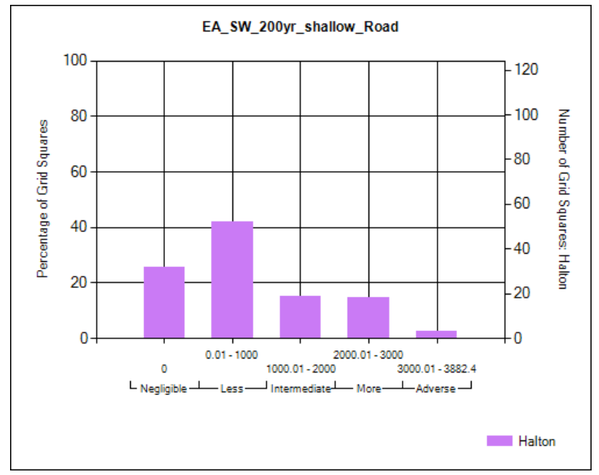
EA_SW_200yr_shallow_Road

- Negligible Consequence
- Less Consequence (0.01 - 1000)
- Intermediate Consequence (1000.01 - 2000)
- More Consequence (2000.01 - 3000)
- Adverse Consequence (3000.01 - 3882.4)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FMfSW 200yr Shallow_Road

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

Flood Zone 2 - Critical Infrastructure

Flood Zone 2 is the Agency's best estimate of the areas of land between Zone 3 and the extent of the flood from rivers/from the sea/from rivers and, or the sea with a 0.1% (1 in 1000) chance of flooding in any year.

Halton Borough Boundary

Hotspots for FloodZone2_KM

Human Health:

FloodZone2_CI

Negligible Consequence

Less Consequence (0.01 - 1)

Intermediate Consequence (1.01 - 5)

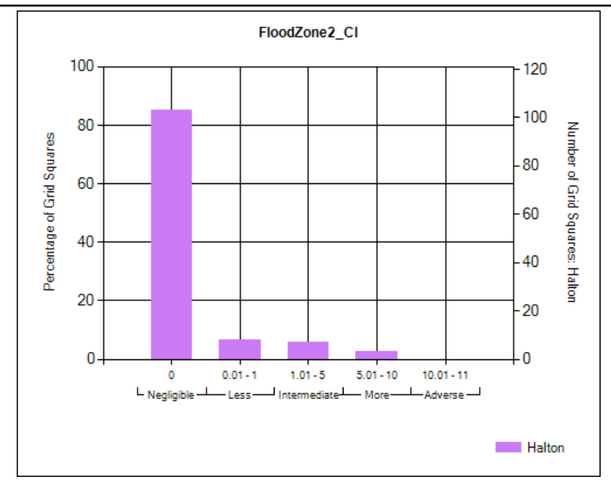
More Consequence (5.01 - 10)

Adverse Consequence (10.01 - 11)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FZ2_CI

0 1 2 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

Flood Zone 3 - Non-Residential

Flood Zone 2 is the Agency's best estimate of the areas of land between Zone 3 and the extent of the flood from rivers/from the sea/from rivers and, or the sea with a 0.1% (1 in 1000) chance of flooding in any year.

Halton Borough Boundary

Hotspots for FloodZone2_KM

Economic:

FZ2_NR

Negligible Consequence

Less Consequence (0.01 - 9.99)

Intermediate Consequence (10 - 14.99)

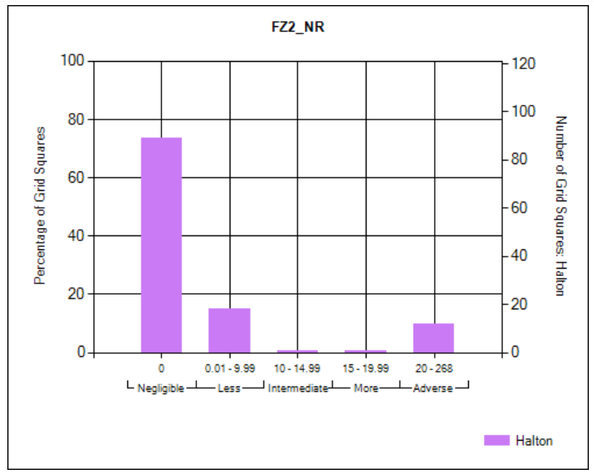
More Consequence (15 - 19.99)

Adverse Consequence (20 - 268)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FZ2_NR

0 1 2 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

Flood Zone 2 - Rail

Flood Zone 2 is the Agency's best estimate of the areas of land between Zone 3 and the extent of the flood from rivers/from the sea/from rivers and, or the sea with a 0.1% (1 in 1000) chance of flooding in any year.

- Halton Borough Boundary
- Hotspots for FloodZone2_KM

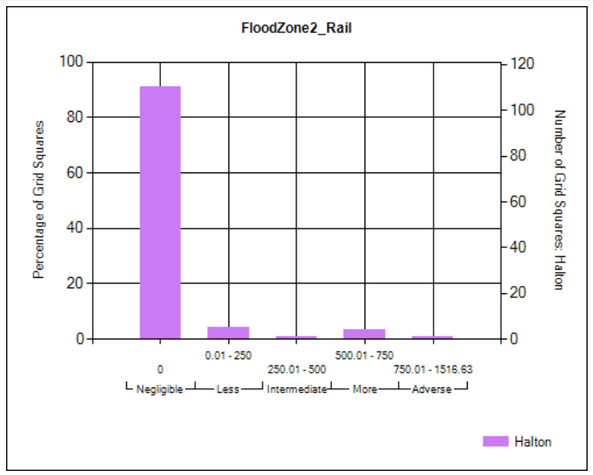
Economic:
FloodZone2_Rail

- Negligible Consequence
- Less Consequence (0.01 - 250)
- Intermediate Consequence (250.01 - 500)
- More Consequence (500.01 - 750)
- Adverse Consequence (750.01 - 1516.63)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FZ2_Rail

0 1 2 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

Flood Zone 2 - Residential

Flood Zone 2 is the Agency's best estimate of the areas of land between Zone 3 and the extent of the flood from rivers/from the sea/from rivers and, or the sea with a 0.1% (1 in 1000) chance of flooding in any year.

Hotspots for FloodZone2_KM

Halton Borough Boundary

Human Health:

FloodZone2_Residential

Negligible Consequence

Less Consequence (0.01 - 9.99)

Intermediate Consequence (10 - 42.99)

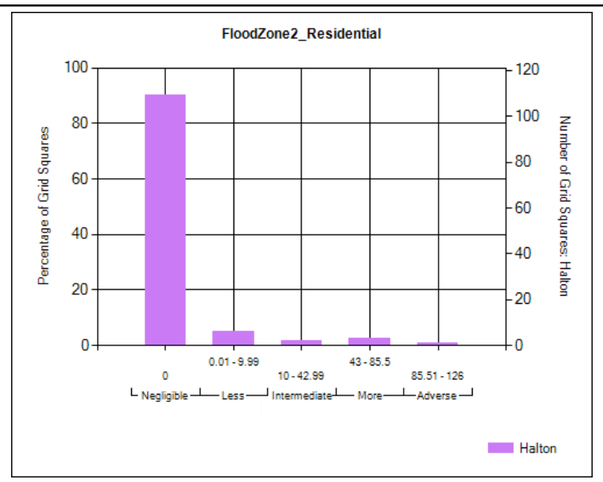
More Consequence (43 - 85.5)

Adverse Consequence (85.51 - 126)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FZ2_Res

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

Flood Zone 2 - Roads

Flood Zone 2 is the Agency's best estimate of the areas of land between Zone 3 and the extent of the flood from rivers/from the sea/from rivers and, or the sea with a 0.1% (1 in 1000) chance of flooding in any year.

Halton Borough Boundary

Hotspots for FloodZone2_KM

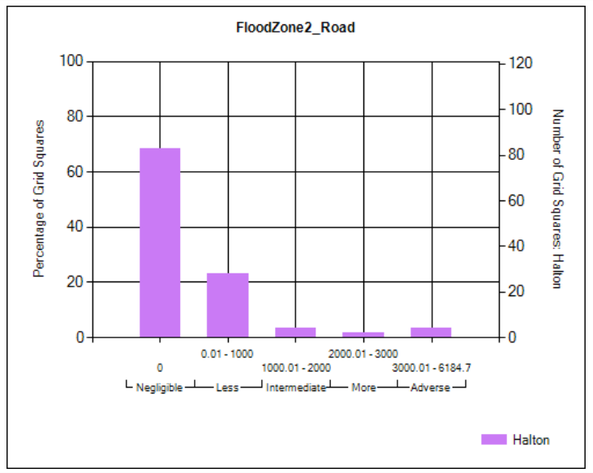
Economic:
FloodZone2_Road

- Negligible Consequence
- Less Consequence (0.01 - 1000)
- Intermediate Consequence (1000.01 - 2000)
- More Consequence (2000.01 - 3000)
- Adverse Consequence (3000.01 - 6184.7)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FZ2_Roads

0 1 2 4 KM

PRFA Analysis
Halton Borough Council

Flood Zone 3 - Critical Infrastructure

Flood Zone 3 is the Agency's best estimate of the areas of land with a 1% (1 in 100), or greater, chance of flooding each year from rivers, or with a 0.5% (1 in 200) chance, or greater, of flooding each year from the sea.

Halton Borough Boundary

Hotspots for FloodZone3_KM

Human Health:

FZ3_CI

Negligible Consequence

Less Consequence (0.01 - 1)

Intermediate Consequence (1.01 - 5)

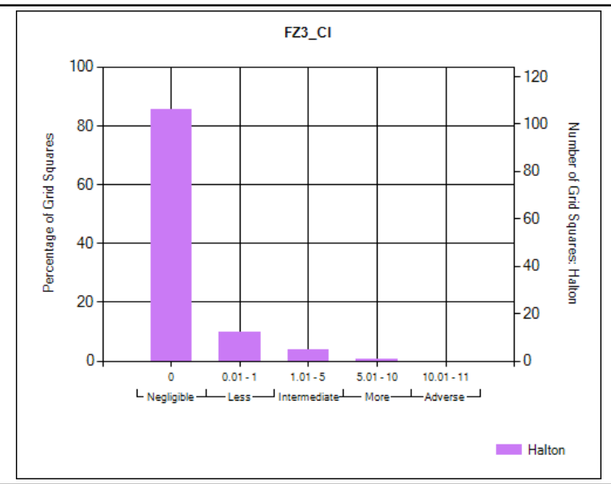
More Consequence (5.01 - 10)

Adverse Consequence (10.01 - 11)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FZ3_CI

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St Helens

Knowsley

Liverpool

Warrington

Ellesmere Port And Neston

Vale Royal

Chester

0 1 2 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

Flood Zone 3 - Non-Residential

Flood Zone 3 is the Agency's best estimate of the areas of land with a 1% (1 in 100), or greater, chance of flooding each year from rivers, or with a 0.5% (1 in 200) chance, or greater, of flooding each year from the sea.

- Halton Borough Boundary
- Hotspots for FloodZone3_KM

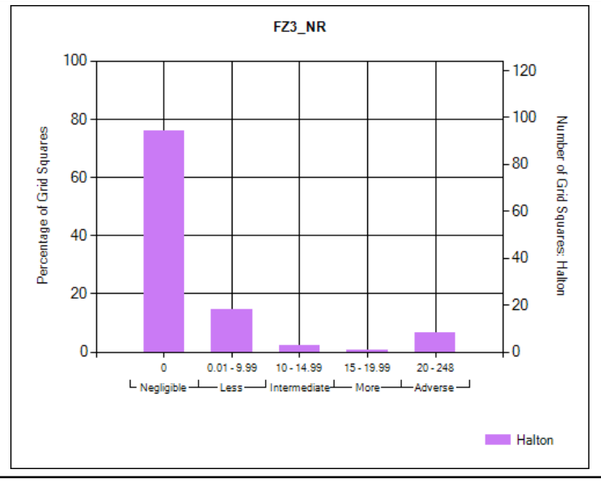
Economic:
FZ3_NR

- Negligible Consequence
- Less Consequence (0.01 - 9.99)
- Intermediate Consequence (10 - 14.99)
- More Consequence (15 - 19.99)
- Adverse Consequence (20 - 248)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FZ3_NR

0 1 2 4 KM

PRFA Analysis
Halton Borough Council

JBA consulting

Flood Zone 3 - Rail

Flood Zone 3 is the Agency's best estimate of the areas of land with a 1% (1 in 100), or greater, chance of flooding each year from rivers, or with a 0.5% (1 in 200) chance, or greater, of flooding each year from the sea.

Halton Borough Boundary

Hotspots for FloodZone3_KM

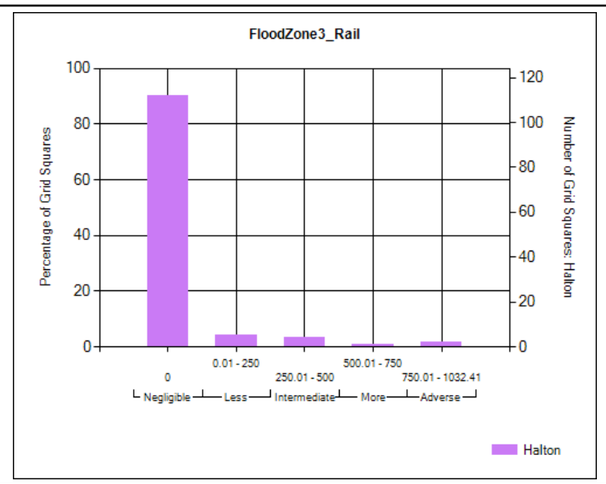
Economic:
FloodZone3_Rail

- Negligible Consequence
- Less Consequence (0.01 - 250)
- Intermediate Consequence (250.01 - 500)
- More Consequence (500.01 - 750)
- Adverse Consequence (750.01 - 1032.41)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FZ3_Rail

0 1 2 4 KM

PRFA Analysis
Halton Borough Council

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Flood Zone 3 - Residential

Flood Zone 3 is the Agency's best estimate of the areas of land with a 1% (1 in 100), or greater, chance of flooding each year from rivers, or with a 0.5% (1 in 200) chance, or greater, of flooding each year from the sea.

Hotspots for FloodZone3_KM

Halton Borough Boundary

Human Health:

FZ3_Residential

Negligible Consequence

Less Consequence (0.01 - 9.99)

Intermediate Consequence (10 - 42.99)

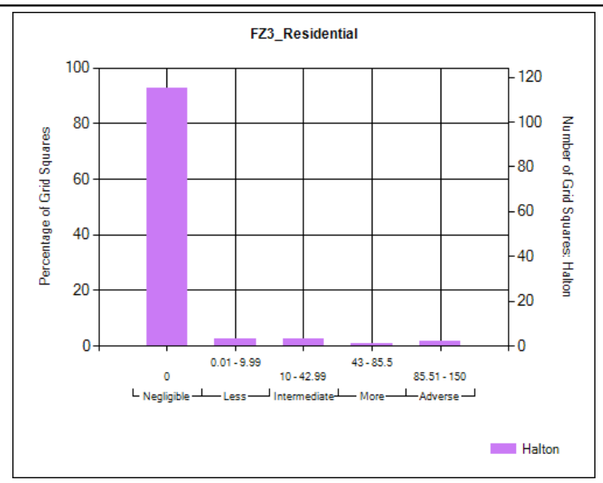
More Consequence (43 - 85.5)

Adverse Consequence (85.51 - 150)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FZ3_Res

0 0.5 1 2 KM 4 KM

PRFA Analysis
Halton Borough Council

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Flood Zone 3 - Roads

Flood Zone 3 is the Agency's best estimate of the areas of land with a 1% (1 in 100), or greater, chance of flooding each year from rivers, or with a 0.5% (1 in 200) chance, or greater, of flooding each year from the sea.

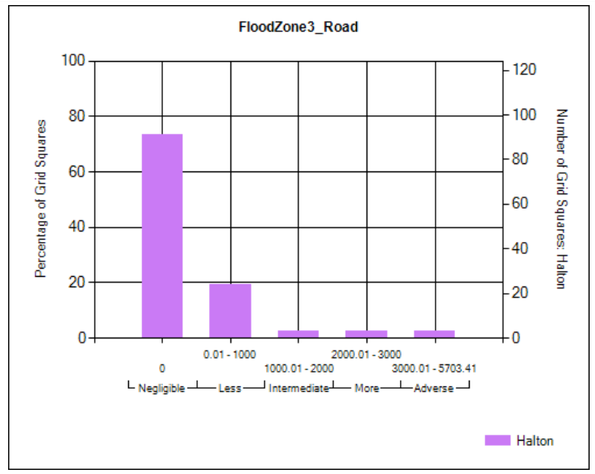
- Halton Borough Boundary
- Hotspots for FloodZone3_KM

Economic:
FloodZone3_Road
- Negligible Consequence
- Less Consequence (0.01 - 1000)
- Intermediate Consequence (1000.01 - 2000)
- More Consequence (2000.01 - 3000)
- Adverse Consequence (3000.01 - 5703.41)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of people > 200 (200/2.34 (nationally agreed average occupancy per household) = 85.5)
2. Critical Services > 10
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting



Drawn: R Whitham

Date: 01/04/2011

Status: Final

Drawing Number: FZ3_Roads

0 1 2 4 KM

Offices at

Atherstone
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Edinburgh
Haywards Heath
Limerick
Newcastle upon Tyne
Newport
Northallerton
Northampton
Saltaire
Skipton
Tadcaster
Wallingford
Warrington

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